THE GLASS INDUSTRY

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MECHANIZATION OF THE GLASS INDUSTRY

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PART I—PLATE GLASS

Premise

This story has its counterpart in every major industrial development. Resemblances far outweigh differences. Combined they form the story of the machine age which is praised or blamed for much of the good and evil of our modern material civilization.

The glass industry is representative as its products have great diversity ranging from necessities to conveniences to luxuries. Their distribution is widespread and their quantity measured either in tons or dollars is a substantial percentage of the materials necessary for our modern plane of living.

In common with other major essentials, the cost of production and distribution determines the extent of use. Like all artificially produced materials, glass has certain physical and chemical characteristics which determine the operations necessary for the production of the final articles.

Therefore, an analysis of the evolutionary route along which glass traveled from its first crude manipulation by hand to its present automatic mechanization is not an isolated phenomenon, but one paralleled by most other products desired by man for his progress toward his higher materialistic living standard.

Scope

The scope of this presentation includes the approximate time period 1900 to 1949, and the three main divisions of the glass industry: Plate Glass, Window Glass and Glass Containers.

The Theme

My theme is based on a multitude of facts or realities covering the transition from manual to complete mechanical operations in the three divisions of the industry. Only such operations are presented as have resulted in progress through following the law with a few exceptions which resulted in stalemates or retrogressions due to infraction of the law.

Such a collection of facts would be meaningless unless by their interpretation we can establish a reasonable theory of principles or laws which explain why success is attained when followed and, conversely, why failure has resulted when violated. Such a theory based upon interpretation of the facts presented is my theme.

Assumption

Our premise depends upon the assumption that materialistic evolution is a universal process and has certain fundamental laws which determine progress; that this is true of plant and animal life in nature and to the consciously predetermined activities of man; that one of these laws is more important than any of the others; that as far as the analysis of the specific subject of this presentation is concerned, it is more important than all the others combined.

For that reason, as well as for the sake of clarity and brevity, I will attempt to show by description and diagrammatic illustration that the path for progress of mechanization in the glass industry depends upon the observance of this law. Conversely, I hope to show that departure therefrom will cause failure and stalemate to such progress.

The Basic Law of Progress

This law is clear and simple. It is perhaps best expressed in the term "Improvement in Efficiency in the Movement of Materials".

The Yardstick

Fortunately, in our capital and profit system, we have a simple yardstick: the "cost in dollars" to measure "movement efficiency". This is not scientifically exact as "movements of materials" requiring energy are measured in "Dynes" or "horsepower" in units of energy, but inasmuch as these are purchased on a dollar basis and the resulting product from its application is sold for dollars and the difference constitutes our profit in dollars, the dollar yardstick will be used.

Power

Any movement of materials requires some means to effect such movement, a motor. Such motors include "man", steam, water, electrical and other power units. Manpower is assisted by mechanical power and thereby multiplies man's efforts. The amount of such mechanical power per unit of population is often used to compare the production results of one nation with another. In general, this is true but in a dollar economy it is not the amount, but the cost of such mechanical power that is the criterion of "efficiency". If a movement of materials can be effected with less dollar cost by man power than by mechanical power, then a manual application will be more efficient.

Fig. 1.

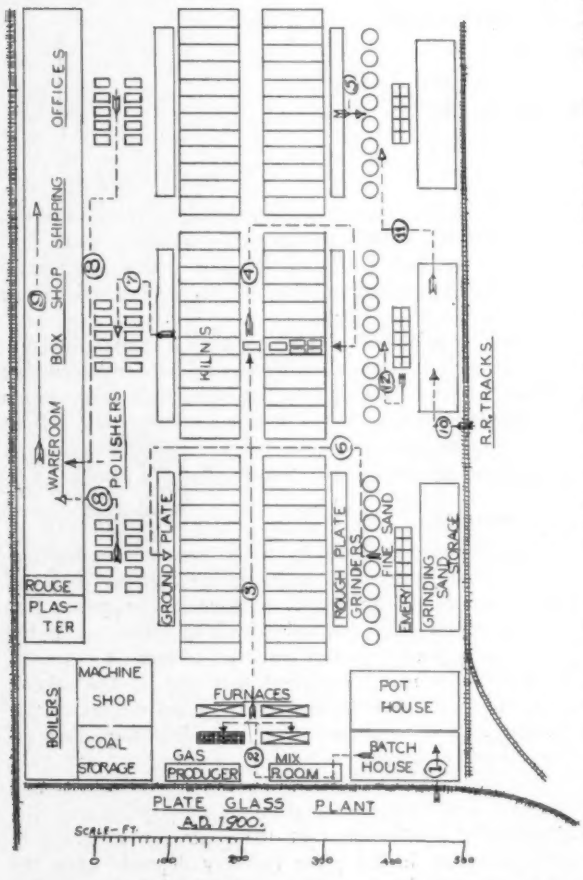


Fig. 1. Routes 1 to 12 inclusive cover a distance of 3.2 miles (including empty returns) representing the distance between stages or operations on the glass. Glass plates, wheelbarrows of grinding sand coal, and batch materials had to be conveyed manually many times which, when multiplied by the number of trips and multiplied again by the number of men engaged, gives a graphic picture of the man hours necessary to perform the task of moving materials. All this travel is eliminated in the continuous system of Fig. 2.

This is not just a theoretical or even minor point. A large division of the glass industry, using the flint glass art, employs manual power to a major extent simply because it is cheaper to use such power. This is because the complicated manual manipulation involved could not be bettered by mechanization at less cost.

The cost of power measured in "horsepower" varies enormously as between man power and mechanical power with relatively little difference between the various forms of mechanical power. One horsepower requires twenty man power hours. On the average the cost of one man hour is approximately $1.00 or $20.00 per horsepower hour. An electrical horsepower (740 watts) equals three-fourths of a kilowatt hour, the latter averaging less than $.01 for industrial operations, three-fourths of $.01 or $.0075 against $20.00. The ratio would therefore be $20.00 divided by $.0075 or 2666 to 1.

This seems almost preposterous to the layman, but unless one can visualize this, the desire and urge for labor saving machinery or mechanization in industry simply cannot be comprehended.

Man is a most expensive motor which can be plainly illustrated by considering the fuel intake of a single tea cup of fuel oil costing one-fourth of a cent, which in a diesel engine will produce power equal to a man working eight hours. Man has skill through the use of his senses, but whenever invention develops tools not requiring skill and man has to sell his labor merely as power, his job is doomed because of its high cost.

This is not the whole story, and we may as well frankly face some disagreeable, sinister facts about the struggles of labor, management and politics. Labor, acting either singly or cooperatively through unions, too often makes no effort to improve producitivity which alone can lift man's plane of living.

On the contrary, too often the unions obstruct this effort, They consistently oppose mechanization, too often they slow down production, their leaders encourage strikes for personal power and against the interest of both labor and the public.

Just now we see a struggle in the unions themselves and purging great numbers who have no loyalty to the companies who pay them, nor the country they should owe allegiance to, not even to the God who made them. Can you wonder that employers rather prefer the quiet machines which work day and night, uncomplainingly, never strike, do the work better and cost one-thousandth of the wage of the lowest unskilled labor.

Where skilled manual power and cheaper electrical power is used the ratio is over double that figure. Therefore, from a cost basis we can afford to use 2 to 5 thousand mechanical horsepower to replace one man. That is why the United States with the greatest amount of mechanical horsepower per capita can successfully compete with a country like Japan with a wage rate as low as $.03 per hour.

Wage rates have often very little relevance in such matters as tariffs, yet at tariff committee meetings the unions usually base their arguments on discriminatory wage rates and tariff schedules have been made on that

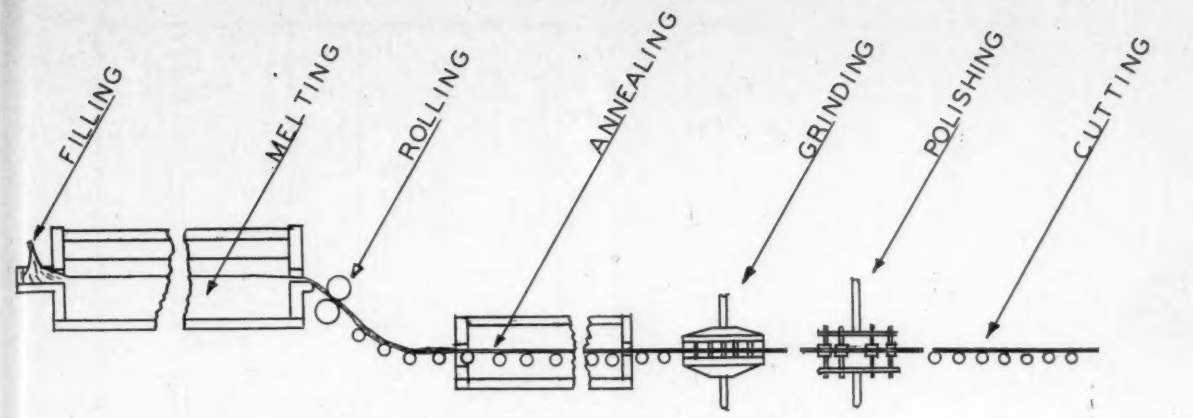


FIG NO.2-LATEST PROCESS COMPLETELY AUTOMATIC 1949

basis. At the same time, labor unions pretty generally oppose mechanization which is their best insurance for high wage rates and their better standards of living.

Interpretative Limitations

Certain limitations must be placed on "efficiency" when used in our basic law as a basis of comparison. One way to express the most important limitation is to say "Other things being equal".

In our following comparisons, the question of quality sometimes arises. If an operation resulting in a poor product is compared to a similar operation producing a fine product, a compensating factor is needed.

Analysis of Three Divisions of Glass Manufacturing

We will take up in order the story of mechanization in Plate Glass, Window Glass and Glass Container manufacture. The successful progress of mechanization in all three has been due to the extent to which developments followed our foregoing premise and assumption:

First, Plate Glass. Unlike the other two divisions to be analyzed, plate glass has always been a mechanized industry. It did not require skilled craftsmen, and the process has not changed in any essential respect since the St. Gobain Company made the first polished plate glass mirror in 1643 for milady.

Plate glass, then as now, was formed by rolling a sheet of viscous glass, annealing, then grinding the surface by iron runners between which the glass was fed sand and emery; then polishing by rubbing felt pads over the surface, using rouge as the polishing agent.

The only essential difference was the increased efficiency in the movement of materials required for effecting the process and its corollary reduced manual labor. Incidentally average quality has improved. Mainly this progress was effected by the substitution of a continuous for an intermittent process which is so evident in industrial operations generally. This eliminated the interminable carrying to and from the raw materials and the glass in the various stages of fabrication.

Fig. 1 is a schematic sketch of a conventional plate glass plant at or just prior to the turn of the century. The arrangement of the various operating units in the plants of that period showed great diversity. The traveling lehr, not continuous but intermittently operated, had been tried out at that time, but was not too successful and was in a phase of transition for several years. At one time, car lehrs, chain lehrs, rod lehrs, and other types were competitive until finally the rod lehr became the standard unit which replaced kilns.

Also at the time indicated, 1900 A.D., table grinders and polishers were used to some extent. However, the plant as shown is fairly representative of the practice of that date. No matter what arrangement of units was used, there were long distances for the movement of raw materials, for the glass itself and for the grinding materials.

Conveyors had not been adapted to the industry, and most of the work of moving the glass and the other materials was done by wheelbarrow and shovel for the raw materials. The glass plates were carried by hand straps requiring as many as twelve men for large plates. There was practically no continuous operation at any stage. Everything was by steps and that most expensive motor (man) supplied practically all the power for the movement of glass and materials from one step to another in the process.

The sketch shows nine routes of travel and the scale of the sketch indicates the length of various routes. I am taking the period from 1900 to 1949 for the evolutionary progress in the plate glass industry during which time it passed from a manual intermittent process to an entirely continuous automatic process by means of mechanization. With few exceptions there were no outstanding or revolutionary inventions, the progress made being largely one of better engineering and construction.

The notable exception was the change from the table casting pot melting system to the continuous tank melting, roller forming ribbon system which, together with continuous grinding and polishing, changed the process from an intermittent to a continuous system. Even this revolutionary process invention did not become commercial until long after it had been proposed and the patents had expired. Incidentally, patents, the usual earmarks of invention, played a minor role in this revolution and lawsuits and royalties were notable for their absence.

A considerable factor in this improvement was due to innumerable applications of electric motors, conveyors, cranes, trolleys, mechanical shovels, and other devices for the auxiliary operations which had been invented and applied long before in other industries. These applications were slowly and progressively added to the

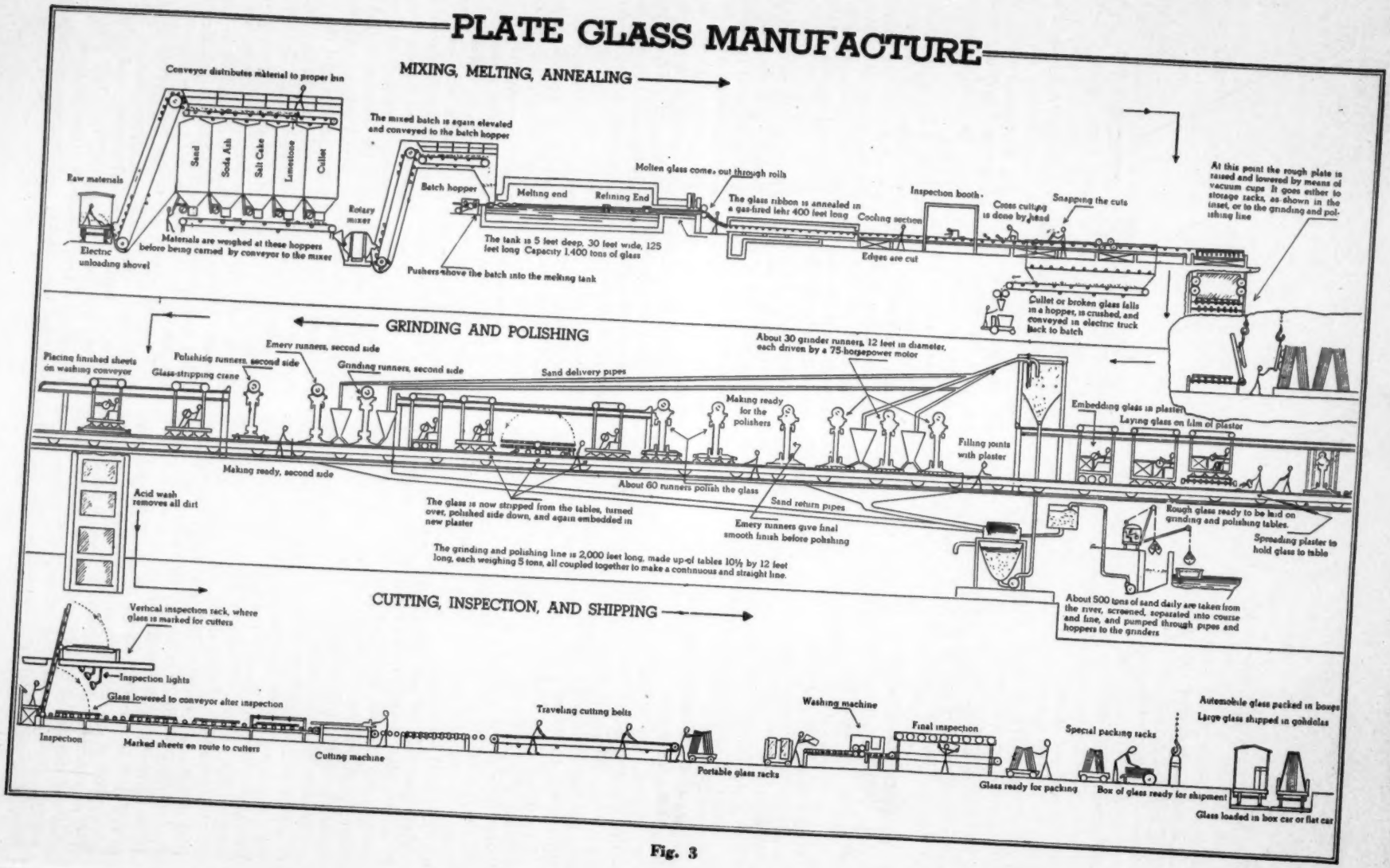


PLATE GLASS MANUFACTURE
MIXING, MELTING, ANNEALING
Conveyor distributes material to proper bin
Sand
Soda Ash
Salt Cake
Limestone
Cullet
Raw materials
Electric unloading shovel
Materials are weighed at these hoppers before being carried by conveyor to the mixer
Rotary mixer
The mixed batch is again elevated and conveyed to the batch hopper
Batch hopper
Pushers shove the batch into the melting tank
Melting end
Refining End
The tank is 5 feet deep, 30 feet wide, 125 feet long Capacity 1,400 tons of glass
Molten glass comes out through rolls
The glass ribbon is annealed in a gas-fired lehr 400 feet long
Cooling section
Inspection booth
Cross cutting is done by hand
Snapping the cuts
Edges are cut
At this point the rough plate is raised and lowered by means of vacuum cups It goes either to storage racks, as shown in the inset, or to the grinding and polishing line
Cullet or broken glass falls in a hopper, is crushed, and conveyed in electric truck Back to batch
GRINDING AND POLISHING
Placing finished sheets on washing conveyor
Glass-stripping crane
Polishing runners, second side
Emery runners, second side
Grinding runners, second side
Sand delivery pipes
About 30 grinder runners, 12 feet in diameter, each driven by a 75-horsepower motor
Making ready for the polishers
Embedding glass in plaster
Laying glass on film of plaster
Filling joints with plaster
Making ready, second side
About 60 runners polish the glass
Sand return pipes
Acid wash removes all dirt
The glass is now stripped from the tables, turned over, polished side down, and again embedded in new plaster
Emery runners give final smooth finish before polishing
Rough glass ready to be laid on grinding and polishing tables.
Spreading plaster to hold glass to table
The grinding and polishing line is 2,000 feet long, made up of tables 10½ by 12 feet long, each weighing 5 tons, all coupled together to make a continuous and straight line.
About 500 tons of sand daily are taken from the river, screened, separated into course and fine, and pumped through pipes and hoppers to the grinders
CUTTING, INSPECTION, AND SHIPPING
Vertical inspection rack, where glass is marked for cutters
Inspection lights
Glass lowered to conveyor after inspection
Inspection
Marked sheets en route to cutters
Cutting machine
Traveling cutting belts
Portable glass racks
Washing machine
Final inspection
Glass ready for packing
Special packing racks
Box of glass ready for shipment
Automobile glass packed in boxes
Large glass shipped in gondolas
Glass loaded in box car or flat car

Fig. 3

Pittsburgh Plate Glass Co.

process from 1900 to 1920 when the new process was definitely up and coming and the old process on the way out.

The New Process

The present modern process of plate glass manufacture is so radically different in appearance that it is difficult to realize that after all there has been no change in the essential glass fabricating cycle; only a change in some of the units or gadgets for performing the same operations as had been previously performed by other units. These operations and even the sequence of steps or stages were identical.

Batch was melted, then the molten glass was rolled, then the rolled sheets (ribbon) were annealed, then the annealed sheets were ground, then the ground sheets were polished, then cut to the sizes to fill the orders, then the cut plates were boxed and shipped to the consumer. Annealing is still done by cooling slowly while the plates change from viscous to a solid condition.

Grinding is still done by blocks of iron with sand and emery used as the abrasive. Polishing is still done by felt polishing pads with rouge as the abrasive. But the end results were revolutionary. The process is now a continuous one in every stage whereas in the old process the glass was fixed or stationary in every stage while the actual glass working operations, such as grinding and polishing, were being effected.

The glass in a single sheet is now continuously traveling by mechanical motive power while in the old process the plates were individually melted, individually rolled, individually annealed, individually ground and individually polished. They were moved from one stage or operation to the next manually. Formerly men did all the moving and now a few men merely watch the glass moving. Their work now consists of observation with an occasional adjustment to fuel valves or electrical control devices.

How did this apparently miraculous evolutionary progress come about without patents or royalties or any change in strictly glass fabricating operations? Starting with the batch materials, conveyors moved the batch from storage bins, automatically weighed and mixed and fed them into a tank furnace at one end. The process became a continuous one replacing manual labor using shovel, wheelbarrow and filling scoop.

This photograph of a casting hall crew made in 1892 consists of 50 men who handled two pot furnaces producing 1½ to 2 million feet of finished glass per annum. As far back as 1926, a fraction of the men shown with a mechanized operation from a single tank furnace produced 24 million feet in one year.

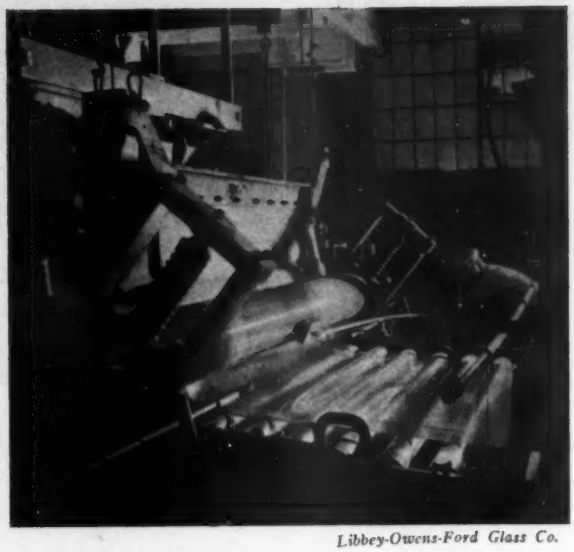
Glass flowed by gravity from the doghouse to the finished glass at the other end of the tank where it flowed out and passed over rollers in a lehr, then passed between grinding blocks which grind both sides simultaneously, then between sets of polishers and on to a cutting table where it was touched by hand for the first time, and cut into stock plates while moving. After that the stock plates were cut to size, packed and shipped to orders in much the same manner as formerly.

Figure 2 is a diagrammatic sketch indicating merely the operations involved and their sequence. Even without a detailed description, it is obvious that this process compared to the old gives a clear illustration of the basic law of evolutionary progress (increased efficiency in movement of materials). But, in addition to this and the obvious improvement due to continuous over intermittent operation, there are many other savings not so apparent. The average quality of glass is better in the new process so that the "Interpretive Qualifications" pre-

Pittsburgh Plate Glass Co.

Removing pot from furnace, 1908, which replaced hand tongs requiring 14 men.

First successful rod lehr for plate glass. Reversing table air cylinder to lift pot for pouring. Up-to-date around 1900.



Libbey-Owens-Ford Glass Co.

Polishing a forming roll in the continuous rolling of plate glass, 1949.

viously explained do not apply and thus the economic comparison or cost can be applied without reservation to the basic "materials movement" law.

Among these savings each adding to movement efficiency are the following: First, reduced amount of batch materials per square foot of rough plate due to the more even thickness of plate rolled by ribbon casting compared to table cast plate. This is a considerable saving as table cast plates have a considerably greater average thickness. Since the latter was not of even thickness, the plate had to be cast with greater average thickness so that the thinnest portions would grind to the required minimum ground glass thickness.

This saving in batch is now approximately 40% of the batch required in table rolled glass per foot of finished glass. *Less Batch Material to Move.*

Second, this reduced the amount of sand necessary to grind the rough plate. The old process required about 30 lbs. of grinding sand per foot of finished glass whereas in the new process between 5 lbs. and 6 lbs. only are required. *Less Sand to Move.*

Third, loss in footage due to matching and lower breakage increased the amount of finished glass per foot of rough plate. Total loss was often 35% in the old process compared to a loss often less than 5% in the new process. *Less Broken Glass to Move.*

Fourth, less power is required for grinding. Power is fairly proportional to amount of abrasive used and time consumed. *Less Coal to Move for Production of Grinding Power.*

Fifth, less power for polishing since the heating up of the plate by friction for proper polishing conditions in the old process required not only the heating up of the glass itself, but also the bed of plaster and table which holds the glass, thus saving a considerable amount of total heat formerly required. The heat absorbed by the polisher pads is also less in the new process as they are in continual use and do not cool off as in the old process when tables were changed. *Less Coal to Move for Production of Polishing Power.*

Sixth, in the new process, plates are not bedded in plaster. *No Plaster to Move.*

Seventh, saving in cost of total power. This consists of two items. The grinding and polishing require large amounts of power, so large that the numerous motors for moving batch, grinding sand, glass plates, coal and other materials are negligible by comparison. Even the power for these auxiliary operations is eliminated from the total due to the reduction in the amount of power necessary for the major operations of grinding and polishing.

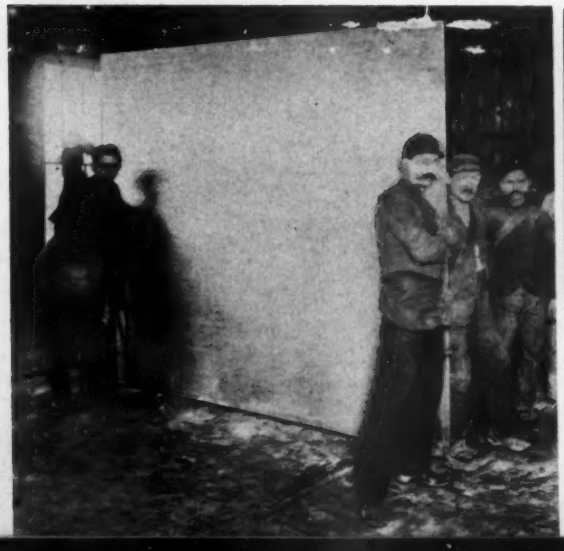
Eighth, another large saving in power cost in the auxiliary operations is due to the replacement of manual power by mechanical power. *Less Man Power Hours.*

Ninth, manual power costs 2,000 to 5,000 times as much per horsepower as mechanical power so this new system which replaces man power by mechanical power increases the efficiency (cost reduction) in materials movement.

The progress from 1900 to 1949 came as a result of individual improvements in various stages. Gradually, conveyor systems were introduced to replace manual labor in moving many materials. Batch materials were mechanically conveyed from cars to batch storage bins. Grinding sand was conveyed mechanically from railroad car or barge to storage piles. Conveyors replaced wheelbarrows for distributing sand from storage piles to grinders and the Hitchcock grader eliminated the mussy

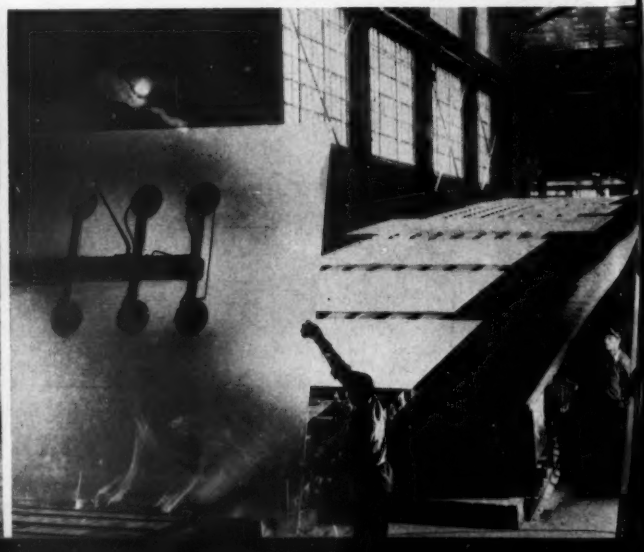
(*Continued on page* 104)

Carrying small rough plate, about 1900.



Carrying rough plate by mechanized means, 1949.

Pittsburgh Plate Glass



WHAT CONSTITUTES GOOD GLASSHOUSE IRONS

By KENNETH McGRATH,* D. P. FORBES† and F. W. DIXON‡

Introduction

For many years, the casting requirements of the glass industry have attracted the attention of foundrymen in their great attempt to supply quality mold irons. Their metallurgical knowledge has been taxed to its capacity in applying available data to the meticulous problems encountered. When these failed or were insufficient, the common practice was to use the entire range of alloying elements in varying amounts in an effort to discover a composition which would be a panacea for all conditions. The search has been a long and seemingly fruitless one, although, we do believe that we are getting nearer to the goal of producing better castings, both in the ferrous and non-ferrous fields.

A few years back, J. S. Vanick did a monumental job of classifying the general requirements and of grading them as to importance. His listing is as follows:

(a)	Machinability	200 points
(b)	Fineness of Surface Finish.....	100 points
(c)	Density or Homogeneity.....	100 points
(d)	High Graphite Particle Distribution	100 points
(e)	Resistance to Heat Checking.....	100 points
(f)	Low Thermal Expansion.....	100 points
(g)	High Thermal Conductivity.....	100 points
(h)	Resistance to Growth and Scaling.	100 points
(i)	Resistance to Surface Deterioration	50 points
(j)	Resistance to Wear, Corrosion and Staining	50 points
	Total	1000 points

Such a measuring device provides a reasonably practical tool to evaluate the desirable characteristics and relative advantages of the mold materials under consideration. There is one main disadvantage to this listing, this being that the cost of the metal is not taken into consideration.

In evaluating glasshouse irons, however, one must bear in mind that the cost of the metal itself is small compared to the machining and finishing cost in the mold shop. Consequently, an iron which produces the mold part at the lowest total cost tends to be the cheapest from the mold user's standpoint.

Let us examine the factors that make for the low cost in the mold shop. In the first place, the casting must be absolutely free from imperfections; a mold shop cannot afford to waste valuable labor on castings which cannot be used. A solid casting is also essential, so that no porosity exists which will obstruct the free flow of the heat through the metal. Even though the porosity does not show on the finished surface of the part, nevertheless heat checks are apt to start if porosity exists in the casting.

From time to time, other phases of the problem have received attention. Some of these are factors contributing to metal cracking; the phenomena of mold wetting; reasons for "dirty" ware; mechanics of mold failure; utilization of nitrogen or other gases to form atmospheres in which glass can be processed and formed; use of gases as alloying elements in metals; and advantages of mold coatings of different types. So little has been accomplished on any of the projects that definite conclusions in any area of research cannot be made. The attitude of the glass industry of applying the results in translating the conclusions into practical utilization in large scale operation will have a greater effect in the future on several of them.

Glass Mold Materials

A listing of materials being presently used in mold applications would include the following:

(a) Unalloyed high carbon gray iron produced by the cupola process.

(b) Low alloyed high and low carbon gray iron produced by the cupola, electric furnace, gas furnace, air furnace or by a duplexing method.

(c) High alloyed high and low carbon irons produced by the electric, gas or air furnace, or by a duplexing method.

(d) Precision cast or semi-precision cast iron and steel alloys.

(e) Special iron alloys, such as Nodular Graphite Type structures.

(f) Plain carbon or low alloyed steels.

(g) High alloyed steels, including stainless and heat resisting types.

(h) Copper base, aluminum base or other non-ferrous alloys.

(i) Pure nickel or nickel-base alloys.

(j) Composite or liner style molds.

(k) Non-metallic molds.

(l) Combinations of many of the above with plating treatments or other coatings.

(m) Some of the above materials with surface impregnation by alloying gases or metallic elements.

(n) Several of the above metals with specialized heat treatments.

The chemical analysis of any of the above, and particularly of those listed under "a" through "d", is not the prime determining factor governing their usefulness in the glass industry. There are many other considerations, but a few are:

(a) *Microscopic Characteristics:* (1) Graphite Size. (2) Graphite Formation. (3) Pearlite Type. (4) Grain Size. (5) Kind and Number of Inclusions. (6) Quantity and Location of Free Ferrite. (7) Presence of Dendritic Structures.

Paper presented before the Eleventh Conference on Glass Problems, University of Illinois, Urbana, Illinois.

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(b) *Physical Tests:* (1) Tensile Strength. (2) Transverse Strength. (3) Hardness. (4) Impact Strength.

(c) *Heat Treatment.*

In the realm of gray iron and alloy iron castings production, an often unrecognized factor comes into importance. The quality and inherent characteristics of the castings are colored by the type pig iron and scrap used in the burden charged into the melting unit, as well as by the kind of melting method utilized. Further, forehearth treatment, inoculations or duplexing is of great importance in determining the characteristics of the end product. To date there has been no satisfactory explanation for the effect of these parent metals and treatments upon the castings produced.

There are two basic types of irons. One is intended to be cast against a chill, while the other is cast in molding sand and is uniform throughout. The castings made with the chill have the advantage of a fine grain structure on the chilled surface. The chills should be of adequate size to give this fine-grained structure to an adequate depth, so that the chilled surface will not be machined away in the mold shop. In general, the castings should be heat treated before machining to relieve residual stresses set up by the drastic cooling of the chill.

For the castings that are cast without chills, the metal must be of such a composition that the casting will be uniformly fine-grained throughout, even though some of the sections may be rather heavy. To accomplish this requires very close control of the chemistry of the metal, the melting operation and the pouring operation.

All glasshouse castings should be given at least a stress-relief heat treatment before leaving the foundry. It has been found from actual experience that the temperature of this particular heat treatment should not exceed 1200° Fahrenheit. The castings should be held at this temperature a minimum of two or three hours and allowed to cool with the furnace. Care should be taken so that the castings after heat treatment are not too "malleable", making it impossible to retain the sharpness of edges required on the mold parts.

At this particular point, we have for your observation two samples of neck ring castings, both of which were cast against a chill. Each has the same chemical composition but they have different heat treatments. The first piece was held forty hours at 1700° Fahrenheit with slow cooling to 1350°, and then held another forty hours after which it was cooled slowly to room temperature. This complete malleabilizing treatment gave a Brinell reading of 140. The other casting received three hours at 1200° Fahrenheit, was allowed to cool with the furnace, and produced a Brinell hardness of 170. You will note from the sample chill its extreme thickness. The reason is that we desire the chilling effect to extend entirely through the casting involved and that after this neck ring is on the forming machine it will have a greater tendency to operate at a more even temperature than a ring which only has slight depth of chill.

The Responsibility of the Foundries

As production speeds on the glass machines have soared, casting faults and stresses have been magnified. The quality, limits, fits and tolerances which are now a necessary part of the inspection program were unheard of just a few years ago. These conditions, together with the fact that many glass producers report castings of seemingly constant characteristics often give radically different results, point to a need for the manufacturers of mold materials to bend unceasing efforts toward higher quality; a greater degree of reproducibility; enlarged research programs for the development of better production techniques, improved casting quality, and discovery of more satisfactory alloys for use in the glass processing fields; and inducement of many concerns in the glass industry to cooperate more fully in service-testing mold materials on which laboratory research had been completed and which would seem to have given evidence of being a superior product.

In the project just mentioned above, a word of caution should probably be given, for it has often been found that the results of tests made in the plants of different manufacturers or on various types of production machines yield test data with seemingly contradictory results. Also, there are so many variables that in any series of experimental trials an open minded approach is required of all interested parties. It is a well authenticated fact that spending some time and effort in winning the full support of even prejudiced or antagonistic men on the "hot end" can mean the difference between an unsatisfactory test or a successful development.

In many instances mold alloys have been "oversold" or recommended for applications for which they were definitely unsuited. Such occurrences should be guarded against to preserve the integrity of the industry.

Responsibility of Glass Producers

The above remarks have been made from the standpoint of suggested procedures by the manufacturers of mold materials. On the subject of recommendations to users of these molds, a few observations should be made to bring to a definition and solution the major problems in the field.

The glass industry generally has the unsavory reputation for furnishing unsatisfactory patterns equipment. A change in this attitude could react in a betterment of casting quality and of the selling prices of the manufactured items.

One of the more important and fruitful plans which the average concern could incorporate would be the compliation of specifications to which all castings, forgings or other products are purchased and accepted. Among the elements listed should be the following:

(a) *Composition:* After a series of tests to determine the most advantageous material for each particular application, a chemical and physical analysis specification can be formulated. Such a standard could be used to govern chemical composition, physical characteristics, microscopic qualifications, type of melting unit, method of mixing or compounding the metal, and other factors as desired. Proof of compliance with these standards should be required regularly, and rejections made if materials furnished do not come within the allowable variation range.

(b) *Appearance:* All of us have seen castings delivered to customers which have been insufficiently cleaned. Such inferior products can react to a marked degree to cause added tool and machining costs. Requirements under this classification could include proper cleaning by the shot blast, grit blast or hydro-blast methods, removal

of chills or core wires, sufficient grinding and rough finishing, freedom from excessive surface defects, etc.

(c) *Heat Treatment:* A casting hard enough to cause difficulty in the machining operation might be far enough off balance to react upon the life in actual production service. In this connection, steps to see that all purchased items have been heat treated in a satisfactory manner would be logical. Such heat treatment should not limit itself to the effect upon machinability, but could readily take care of proper changes in microstructure, such as the reduction of excessive carbide areas, the altering of dendritic structures to more favorable or normal ones, etc. The ceiling temperatures of the treatment should be determined so that the desired results will be obtained. The supplier of the castings should give satisfactory assurances that the furnace in which the heat treatment is performed has proper controls and is so constructed that overheating does not occur.

PRODUCTION COST HISTORY for Job — Serial No. _____

Wt. Each _____

Type Production Equipment _____

Mfgr. Mold Castings _____ Alloy _____
Mfgr. Plunger Castings _____ Alloy _____
Mfgr. Ring Castings _____ Alloy _____
No. Molds _____ No. Plungers _____ No. Rings _____

Total Cost

Original Mold Cost	Material Cost _____ Labor Cost _____ Burden @ ____% _____	$
Maintenance and Replacement Cost	Material Cost _____ Labor Cost _____ Burden @ ____% _____	$
Total Mold Cost	Material Cost _____ Labor Cost _____ Burden @ ____% _____	$
Total Hours Actual Production Life _____	Total Cost Per Production Life Hour	$

Production History:

From _____ to _____ = _____ Hrs. @ _____ SPM
From _____ to _____ = _____ Hrs. @ _____ SPM
From _____ to _____ = _____ Hrs. @ _____ SPM

Total Ware Manufactured _____ M Gross
Ware Inspected and Packed _____ M Gross
Ratio Production to Packed Ware _____ %
Ware Packed Per Mold _____ Gross
Total Cost Per M Gross Packed _____

Remarks: _____

At the discretion of the purchaser, and in cooperation with the supplier, other specifications might be agreed upon. These could include proper identification of the product, painting or other surface protection, etc.

A second field of cooperative effort which is nearly universally neglected is the keeping of proper records of production. Probably there are many cases in which purchasers of mold materials choose a product because of its price, because of the personality of the salesman, or because of other equally irrelevant reasons, rather than because of the amount of good glassware which can be produced by them at the lowest possible cost. In such cases the fact is often overlooked that there is no mold material which has a universally decisive advantage in all applications. In other words, if the problems are properly weighed, the possibility exists that a material which gives superior results as a plunger should not be used for valve applications, or that a good ring alloy need not necessarily produce a mold casting that would give satisfactory service. To find the place of ultimate usefulness of the products available, and to balance each against the original cost, as well as the cost to keep them in useful condition, is a fruitful field of investigation. In this connection, a suggested Production Cost History sheet is shown herewith. It is actually a composite of several which have been noted in contacts over the industry, and is not meant to be used as outlined but is intended to show the majority of the elements to be considered in arriving at the actual ratio of cost of mold alloys to glass produced, and trying to determine the best alloy combinations for each application.

Before leaving this point, an item should be mentioned which is a constant source of irritation to aggressive and progressive suppliers of alloys to the glass industry. A manufacturer of mold alloys may have expended considerable time, effort and money in experimentation to develop and test a product which shows promise of being an improvement and of delivering added hours of service in the glass factory. Sample castings are made at the expense of the casting manufacturer and presented to one or more glass processors with a fervent request that an accurate record be kept of the history of the special alloy. That becomes the end of the matter, for the part may never be machined, or it may promptly be lost, or it may become mixed into other lots of castings and its identity made questionable, or any number of other mishandlings may occur. Such conduct is common in spite of the claims of the glass industry that no laboratory type test can parallel the operating conditions encountered in the glass production cycle. If the latter is true and if the glass producer is interested in improving the mold equipment cost histories, he must become willing to offer assistance in developing superior alloys designed particularly for conditions existent in his plant.

General Conclusions

The operating conditions from plant to plant throughout the industry varies over such a wide range that no one "best" mold material has been designed.

In each plant there are so many varying requirements, and there is such a wide range of alloys from which to choose, that the likelihood is that a number of alloys can advantageously be used to counteract the maze of problems encountered.

A continual search should be engaged in to locate materials more applicable to existent conditions in each manufacturing plant.

Every glass manufacturer should take steps to set up specifications to govern the quality of his purchases.

There is no doubt that the addition of the proper alloys to glasshouse castings has a very beneficial effect in controlling solidification, grain structure, the response to heat treatment and their usefulness in the glass production cycle.

The principal alloys used in the glasshouse irons are chromium, nickel molybdenum and copper. Usually two or more are used simultaneously, each one contributing a special quality to the metal.

The mold producers must take all possible steps to guarantee unerring quality and to conduct research to develop improved alloys.

In final conclusion, a good glasshouse iron must first

(*Continued on page* 106)

THE GLASSICLE

By J. B. MURGATROYD

The Rockware Glass Syndicate, Ltd., Middlesex, England

The Glassicle is a glass icicle. So far it has only appeared on the movie set where its usefulness lies in the preservation of its shape no matter how hot the atmosphere becomes. But no doubt someone, someday, will wish to build himself a permanent snow and ice-bound building, or portion of landscape, which will serve to remind him of winter's cold even on a hot summer day. If so, he can apply to The Rockware Glass Syndicate of England for a few gross of assorted glassicles to go with the synthetic snow.

A couple of years ago a harassed property man was worrying over the problem of providing non-melting icicles for a film, and he happened to mention the problem to J. C. Gregory, of Rockware, who was sufficiently intrigued to go away and do some thinking. Together with D. Waters, who is an expert lamp-worker amongst other things, he finally produced bogus icicles which are almost better-than-life.

The obvious thing to do was to use glass, but there is a difficulty in working solid glass rod two or three inches in diameter and two feet long, quite apart from the annealing problem. The specification called for icicles from a few inches to a few feet in length; hence, these difficulties had to be overcome. The answer was sought by blowing hollow icicles from tubing. Neither the solid nor the hollow variety showed the brilliant sparkle of the authentic H_2O icicle, but the final touch of nature was achieved by filling the "glassicles" with the very material they were intended to simulate; in other words, water.

After a few trials, Waters was soon in full production rhythm and, by a combination of twisting and pulling while heating in a blow-lamp flame, he tortured a few score feet of tubing into a magnificent collection of

(*Continued on page* 110)

Icilist Waters shown blowing a glassicle.

RECENT TRANSLATIONS OF RUSSIAN PAPERS OF INTEREST TO THE GLASS INDUSTRY

Abstracts of two papers which appeared in the Russian journal of the glass and ceramic industries.

HARDENING OF GLASS

Two papers dealing with hardening of glass have appeared in *Steklo i Keramika* (Glass and Ceramics), No. 5 (1949). S. G. Lioznyanskaya and Z. I. Bronshtein (p. 3-6) studied the effect of air pressure and of the distance between nozzle and glass sheet on the properties of hardened glass. G. M. Bartenev (p. 7-12) published a theoretical and experimental investigation on stresses caused in a glass sheet by its cooling.

In the first mentioned study, glass sheets 6 mm. thick and 100 x 200 mm., 240 x 240 mm., or 400 x 400 mm. moved between 2 lattices of nozzles. Each lattice had diameter of 500 mm., the distance between 2 nearest nozzles was 25 mm. and the diameter of each nozzle was 5 mm. The experimental work consisted of the following steps.

(1) The velocity of air flow at the glass surface was determined as function of the distance d between the nozzle orifice and the glass. If air leaves the nozzle at the speed of 85 m./sec., the velocity at the glass surface is 42m./sec. if $d = 10$ mm., 31 m./sec. if $d = 20$ mm., 23 mm./sec. if $d = 30$ mm., 15 m./sec. if $d = 50$ mm. and 9 m./sec. if $d = 60$ mm. The distance d used in (Russian) industrial cooling units is 90 mm. Therefore, the velocity of air at the glass surface is less than one-tenth of the original velocity and a corresponding fraction of the cooling effect of the air is lost.

(2) These results would indicate the possibility of improving the performance of the air blasts by reducing distance d. However, small distance d may cause non-uniform cooling of the glass sheet as, at small d, areas directly opposite to the nozzles may cool at a higher rate than the other areas. A sheet of plywood was substituted for the glass sheet. It had holes, 3mm. in diameter, in the distance of 8 mm. from each other. Each of these holes could be connected with a micromanometer indicating the air pressure on the area of the hole. There was a difference between the air pressure on different holes, and this difference increased when d decreased; when d was 15 mm. the difference reached 50%. But there were also air currents present directed along the glass surface, and they may be expected to reduce the differences in cooling caused by differences in the air currents directed toward the surface.

(3) Because the above preliminary tests strongly suggested that lowering of d may improve the performance of actual hardening units, glass sheets were cooled by air injected at the pressures of 3, 5, 10, 15, 20 and 25 mm. mercury while d was 55, 40, 30 or 15 mm.

The quality of the hardened glass obtained in these experiments was judged by 4 methods. (a) The path difference between ordinary and extraordinary light beams for 1 cm. of the sheet thickness (N); (b) The percentage of specimens (240 x 240 mm.) destroyed by a steel ball of 760 g. falling from the height h; (c) The average size of fragments produced in destroying specimens of 200 x 100 x 6 mm. by a falling sphere; and

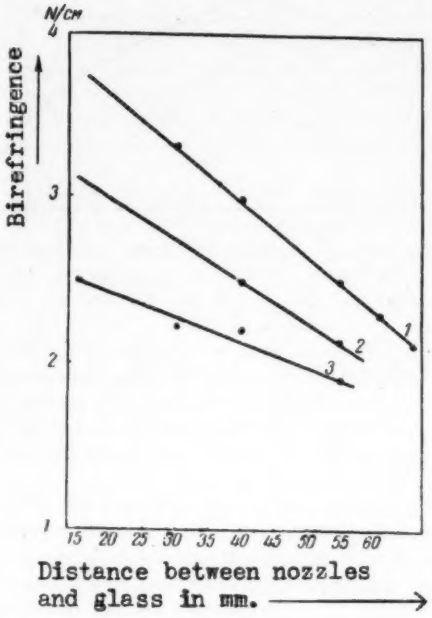


FIG. 1

(d) The percentage of specimens (240 x 240 mm.) broken by a bending stress B.

The results are shown in Figs. 1 and 2 and Tables I and II. Fig. 1 demonstrates that the birefringence N of the glass decreases when the air pressure decreases and the distance (d) between nozzle and glass increases. Curve 1 refers to air pressure of 20 mm. Hg, curve 2 to 10 mm. Hg, and curve 3 to 5 mm. Hg. The abscissa of the figure is d in mm.

Table I compares the strength of the experimental specimens with that of industrial specimens hardened at air pressure of 40 mm. Hg and d equal to about 90 mm., method (b) above being used.

TABLE I.

Cracking resistance of toughened glass. Percentage of specimens cracked by a ball of 760 g.

Height h in meters	*Industrial specimens from "Mosautosteklo"*	*Gorki plant*	*Experimental specimens*
0.75	—	20	—
1.00	10	20	—
1.25	40	20	20
1.50	20	20	—
1.75	30	10	30
2.25	—	10	—
2.75	—	—	20
over 2.75	—	—	30

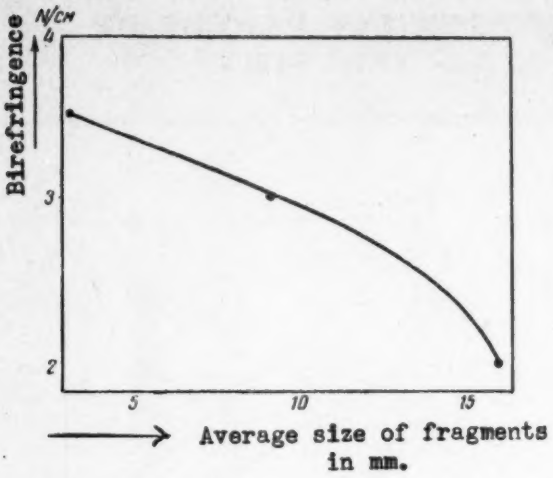


FIG. 2

In hardening the experimental specimens, air pressure of 5 mm. Hg and distance d of 40 mm. were used. It is clear that reduction of the pressure from 40 to 5 mm. Hg was more than offset by reduction of the distance d from 90 to 40 mm.

In Fig. 2 the average size of fragments (in mm.) is plotted along the abscissa and the birefringence N along the ordinate. Apparently, the curve obtained does not depend on the manner by which the birefringence N has been achieved, i. e. on the air pressure and distance d employed, although the absolute size of the fragments depends on the dimensions of the specimen. It is seen from Fig. 2 that the average fragment is 15 mm. when N is about 2, and 5 mm. when N is about 3.2. Fig. 1, curve 2 shows that the increase of N from 2 to 3.2 can be achieved by reducing d from about 60 to about 16 mm. This reduction of d is, therefore, sufficient to diminish the fragment size from 15 to 5 mm.

In Table II, as in Table I, the strength of experimental specimens is compared with the strength of industrial samples, but the testing procedure is (d) above. The experimental glass sheets obtained at low air pressure prove to be as good as the industrial samples.

TABLE II.

Rupture by bending. Percentage of specimens broken by stress B.

Bending stress B in kg./sq. cm.	*Industrial specimens from "Mosautosteklo"*	*Gorki plant*	*Experimental specimens*
less than 700	—	20	—
700 to 850	30	40	40
850 to 1000	50	10	30
1000 to 1250	10	30	20
1250 to 1500	—	—	10
over 1500	10	—	—
average	965	895	940

(4) Under plant conditions, reduction of d to or below 50 mm. appeared to be impracticable. However, even a smaller reduction of d was beneficial. The glass plant "Mosautosteklo" diminished d from 90 to 60 mm. and the air pressure from 35 to 27 mm. Hg and thus increased the birefringence N from 2.0 to 2.4.

* *

Bartenev's theory employs several assumptions. It is assumed that as far as hardening is concerned every glass has two characteristic points of temperature, T_c and T_g. If the glass is heated above the temperature T_c and immediately placed in a space kept at a low temperature (say, T_o), then the resulting stress in the glass specimen should be independent of whatever was the highest temperature the glass was brought to before cooling. On the contrary, if the highest temperature before cooling was below T_c, the resulting stress should depend on it.

This, the first, assumption was tested by heating glass plates (of Fourcault type) in an oven at a temperature ranging from 380°C to 700° (716° — 1292F) and cooling them in air of 25°C (78° F). The resulting stress was determined as birefringence Δ defined as the difference (in 0.0000001 cm., i.e. millimicrons) between the paths of ordinary and extraordinary beams along 1 cm. of the thickness of the plate. The value of Δ naturally varies across the plate, and its magnitude in the center of the plate is plotted in Fig. 3 along the ordinate. The abscissa of this figure represents the temperature reached by the plate before cooling started. The light curves shown in the figure refer to plates of 8 different thicknesses: sample 1 was 26.46 mm. thick, sample 2 20.94 mm., sample 3 16.96 mm., sample 4 16.14, sample 5 12.38, sample 6 9.13, sample 7 5.82, and sample 8 2.06 mm.

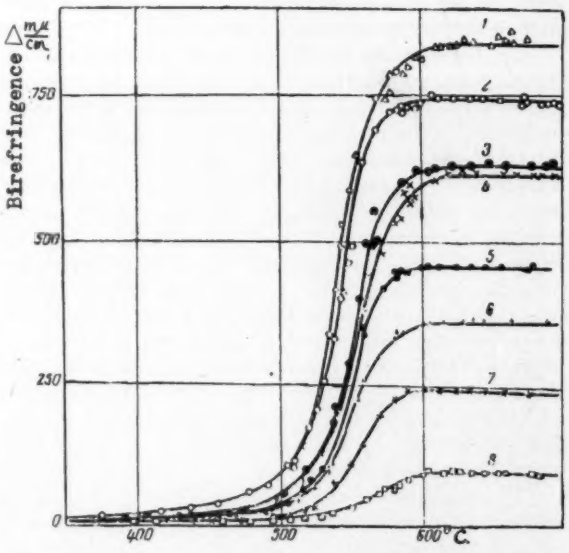


Fig. 3. Heating temperature before quenching.

It is seen that birefringence Δ becomes constant when the maximum heating temperature rises above 600°C. Hence, the first assumption is justified, and T_c of the glass used was about 600°C (1112°F). As Fig. 3 shows, T_c was independent of the thickness of the plate.

The second assumption concerns temperature T_g.

(*Continued on page* 108)

HAZARD CONTROL FOR GLASS BATCH PLANTS

By FREDERICK S. KRIGER, Manager
Plant Engineering Dept., Corning Glass Works, Corning, N. Y.

The inherent hazards of glass batch plants can be overcome by determining what they are, where they occur and applying corrective measures.

A glass batch plant is primarily a material handling operation. The materials are to more or less extent toxic, dusty, abrasive and in a finely divided state. As a result, the operation of handling them presents hazards to the persons who must come in contact with them.

The material handling problem falls into unloading, handling to storage, storing, assembling and weighing, mixing and distribution of the mixed material.

In designing a new batch plant or redesigning an old plant, the following suggestions will reduce the hazards. First, design to reduce the number of men involved in the operation to the minimum. This requires a plant where every movement possible is done mechanically. Initial increased capital costs will result but the savings in lower operating rates will justify the cost. The result will be a reduction of the exposure to the employees. Consideration should be given to the following:

1. Whenever possible, purchase raw materials in bulk and take shipments by hopper bottom or tank cars which allow for gravity unloading. Other bulk materials can be unloaded by mechanically operated shovels. If bagged material is necessary, request shipment on pallets. If this is not possible, load in car on pallets and store on pallets. Reduce handling to only loading and unloading pallet.

2. Handle all materials in bulk by conveyors, elevators, pneumatic or other mechanical means, keeping such systems entirely enclosed. Enclosures must be tight but at the same time easily accessible for maintenance and cleaning in case any clogging should occur. Doors, cleanouts, removable panels must be gasketed and should be held in place with cams, quick acting locks or wing nuts. Decrease transfer points to a minimum, as any change in the velocity of the material will cause dust.

Periodic cleaning at frequent intervals of all conveying equipment is a requirement of such a system. Vacuum cleaning has the advantages of not raising dust and being more efficient from the standpoint of the overall cleanliness. All phases of housekeeping must be maintained continuously at a high standard.

In case of packaged materials, store in an orderly way as many units as are possible in a single handling. Watch that allowable floor loadings are not exceeded, that piles do not become too high, and that sufficiently wide aisles are provided for ease in transporting. Spillage from broken containers should be immediately cleaned up at the time the material is stored, preferably by vacuum, and damaged containers should be the first to be used.

When bulk storage is used, gravity flow bins to weighing reduce the amount of mechanical handling equipment to be installed. Tight connections to and from the bins into the conveying system must be maintained and the bins must be vented with such size dust filtered vents that the air velocity in or out is not excessive.

Provision should be made so that materials which cake while standing can be recirculated periodically. Thus it becomes unnecessary for employees to enter the bin to loosen or break materials. Entrance to the bin should be large enough to admit easily anyone who has to enter and proper safety ladders should be provided for access from top to bottom.

Materials should be handled, insofar as possible, by completely enclosed chutes or conveyors to the weigh scale which can also be completely enclosed. A slight negative pressure in this enclosure will reduce escape of dust without the loss of valuable material through the exhaust.

Reduce the distance through which the material has a free fall from the point of discharge into the weigh hopper to a minimum to further reduce dusting. Here again, easy access should be provided for cleaning and maintenance. In the enclosure avoid pockets, corners, ledges or surfaces upon which materials can accumulate.

From the weigh hopper to the mixer the circuit through which the material moves should be dust-tight at both the weigh hopper and mixer. The mixer itself should operate under a slight negative pressure to reduce the escape of dust.

If the mixed material is to be distributed as a unit batch, the mixer discharge should be in an enclosed room in which the distributing container is set with the man outside during the loading operation. Here again, a slight negative pressure should be maintained. Containers for distributing the mixed material should not be filled to the point where they can drip material while being moved.

If the mixed material is distributed mechanically, the system should be totally enclosed throughout its entire length following the practices set forth previously in handling bulk materials.

Having reduced the number of employees to a minimum through mechanization and at the same time reducing the hazards to the employees, consideration should be given to any remaining hazards. This can be done through the following:

1. Provide proper type of respirators, properly fitted for protection when contact with materials becomes necessary. A system of cleaning respirators should be provided so that the individual can turn in his respirator daily, receiving a clean one at that time. The man should always receive his own respirator back.

2. Goggles of the proper type properly fitted should also be used whenever the need is shown.

3. Safety shoes should be worn by all exposed to foot hazards.

4. Clothing used in handling mixing materials should be left in the locker room and never worn home. Cleaning of such clothing should be provided weekly. Street clothing should not be allowed to become contaminated with mixing materials and a shower should be required before ringing out at the end of a shift.

(*Continued on page* 111)

An address given before the Glass Division of the National Safety Council.

INVENTIONS AND INVENTORS

A Summary of Recently Issued Patents of Interest to the Glass Industry

Feeding and Forming

Corning Feeder. Fig. 1. Patent No. 2,493,260. Cyril T. Paquette and Lynn B. Webb assigned this invention to Corning Glass Works. The object of the invention is to prevent contaminated glass from being incorporated in the glass being delivered to form the ware.

The figure shows a rotating needle 20 positioned over an outlet 13. A trough 14 near the surface of the glass allows the contaminated glass, which is set in rotary motion by the needle, to flow away while the good glass passes to the submerged outlet. Modifications are shown involving the same general idea.

The following references are of record in the file of this patent: United States Patents: 1,737,525, Soubier, Nov. 26, 1929; 2,036,872, Honiss, Apr. 7, 1936; 2,050,205, Bailey, Aug. 4, 1936; 2,063,842, Honiss, Dec. 8, 1936; and 2,085,245, Woods, June 29, 1937.

Glass Working Machine. Patent No. 2,494,387. This invention by John S. Harker of Vineland, N. J., was assigned to Owens-Illinois Glass Company. The machine is for the purpose of dividing and bottoming glass blanks which might be formed into vials although this is not stated.

The machine is of the turret type and eight sheets of drawings are required to disclose the construction. It is said to be an improvement over what is shown in Patent No. 1,688,190 to Koenig. The patent itself should be examined by any one interested.

The following references are of record in the file of this patent: United States Patents: 806,168, Morrison, Dec. 5, 1905; 1,322,779, Frederick et al., Nov. 25, 1919; 1,621,359, Fagan et al., Mar. 15, 1927; 2,002,432, Comoy, May 21, 1935; 2,050,088, Dichter, Aug. 4, 1936; 2,125,017, Halberson, July 26, 1938; 2,227,224, Kimble et al., Dec. 31, 1940; 2,284,089, Hahn et al., May 26, 1942; 2,331,014, Brown, Oct. 5, 1943; and 2,364,673, Stuckert et al., Dec. 12, 1944. Foreign Patents: 256,817, Germany, Feb. 20, 1913; 527,692, Great Britain, Oct. 14, 1940; and 852,138, France, Oct. 16, 1939.

Hartford-Empire Company has surrendered the following three patents to the general public:

Patent No. 2,073,571. Dated Mar. 9, 1937. Glass Working Apparatus.

Patent No. 2,073,572. Dated Mar. 9, 1937. Feeding Molten Glass.

Patent No. 2,073,573. Dated Mar. 9, 1937. Glass Feeding Mechanism.

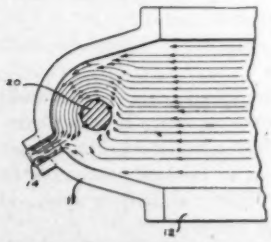


Fig. 1. Corning Feeder.

Furnaces

Corning Electric Melting Furnace. Fig. 2. Patent No. 2,490,339. Charles F. De Voe assigned this invention to Corning Glass Works. The invention uses carbon electrodes and in order to prevent discoloration of the glass due to the high temperature of the carbon, the maximum temperature is produced remote from the carbon electrodes and also near the cooler side walls of the furnace.

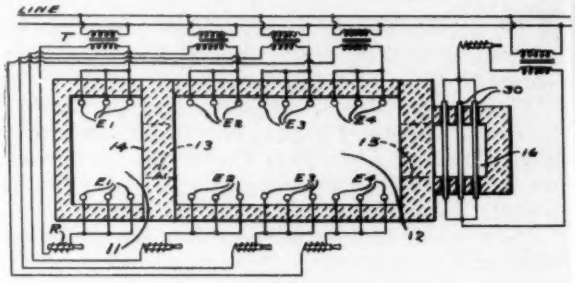


Fig. 2. Corning Electric Melting Furnace.

The figure shows a premelting chamber 11 connected to a combined melting and fining chamber 12 by a submerged throat 13 in the wall 14. This chamber is in turn connected to a working chamber from which the glass is withdrawn in any desired manner, by a submerged throat 15. The batch in the premelting chamber is melted by the Joule effect from a series of vertical rod-like electrodes E1 arranged on opposite sides of the chamber. The glass in the chamber 12 is further heated by electrodes E2, E3 and E4. The glass in the working chamber is heated by resistor elements 30 arranged above the surface of the glass.

The Patent Office cited 12 references during the prosecution of this application which are as follows: 1,062,362, Sauvageon, May 20, 1913; 1,552,555, Gravel, Sept. 8, 1925; 1,593,054, Arbeit, July 20, 1926; 1,597,073, Keenan, Aug. 24, 1926; 1,880,541, Wadman, Oct. 4, 1932; 1,987,973, Wadman, Feb. 14, 1933; 2,122,469, Hitner, July 5, 1938; 2,225,616, Borel, Dec. 24, 1940;

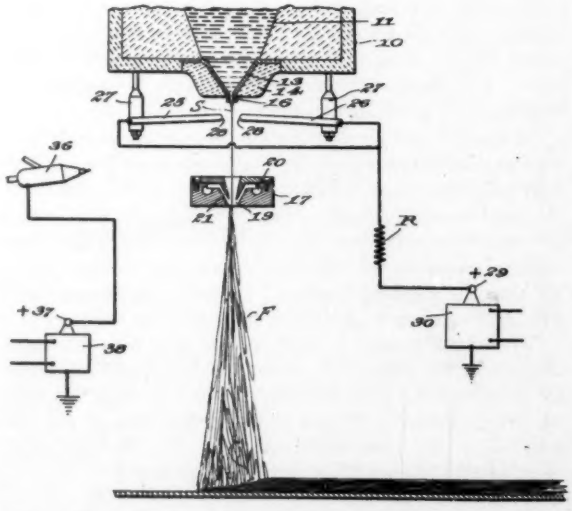


Fig. 3. Coating Glass Fibers.

2,267,537, Romazzotti, Dec. 23, 1941; 2,350,734, Dumarest, June 6, 1944; and 2,397,852, Gentil, Apr. 2, 1946. Foreign Patents: 350,474, Great Britain, June 8, 1931.

Glass Compositions

Acid Resistant Enamel. Patent No. 2,492,523. This invention was assigned to Metal & Thermit Corporation of New York, by William W. Coffeen and Ralph R. Danielson.

Three examples of frit batches coming under this patent are given of which composition C has the lowest acid resistance. The patent gives several modifications of the composition and full directions for use.

Enamel Frit Batch Composition, Sample	A	B	C
Batch Ingredients:			
Flint .....grams..	393	393	393
Titanium dioxide .....grams..	60	60	60
Borax .....grams..	116	116	116
Soda Nitre .....grams..	70	70	70
Soda Ash .....grams..	170	170	142
Fluorspar .....grams..	35	35	35
Sodium Silico Fluoride....grams..	15	15	15
Litharge .....grams..	190	190	190
Sodium Antimonate .....grams..	120	...	97
Barium Antimonate .....grams..	...	120	...
Barium Carbonate .....grams..	...	...	50
Acid Resistance	A	AA	D
Reflectance:			
Blue	79.2	76.4	77.0
Green	82.5	79.2	77.3
Amber	83.1	79.6	77.4
Oxide Content:			
Na_2O .....grams..	16.7	14.7	14.7
CaO .....grams..	2.5	2.5	2.5
B_2O_3 .....grams..	4.2	4.2	4.2
SiO_2 .....grams..	39.6	39.6	39.6
TiO_2 .....grams..	5.9	5.9	5.9
F_2 .....grams..	2.6	2.6	2.6
PbO .....grams..	18.8	18.8	18.8
BaO .....grams..	...	3.9	3.9
Sb_2O_5 .....grams..	9.9	8.0	8.0

The following references are of record in the file of this patent: United States Patents: 2,414,633, Bryant, Jan. 21, 1947. Foreign Patents: 628,487, Germany, 1936.

Glass Wool and Fibers

Coating Glass Fibers. Fig. 3. Patent No. 2,491,889. This patent is owned by Owens-Corning Fiberglas Corporation being assigned to it by Willard H. Bennett and Robert B. Taylor. According to the patent, the spray particles and the material to be sprayed are electrostatically charged with charges of opposite polarities so that the spray is attracted to the material. The coating may be in the nature of a lubricant or other material and the fibers may be made in accordance with any well known method.

The fibers are drawn from openings 16 in a bushing 13 and pass to a blower 17 which produces the filaments F. Plates 25 and 26 charge the glass with one polarity while the coating material is discharged from

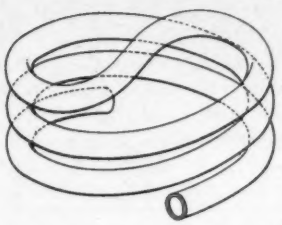


Fig. 4. General Electric Tube Coiling Machine.

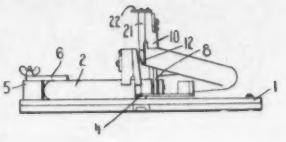


Fig. 5. Machine for Making Circular Fluorescent Lamps.

a spray gun 36 with a charge of opposite polarity. In this manner the hot filaments are uniformly coated with a lubricant, coloring matter or other material.

The Patent Office cited 18 references during the prosecution of this application.

Fibrous Glass Article. Patent No. 2,494,259. Corning Glass Works acquired this invention from Martin E. Nordberg. The primary object of the invention is to form glass fibres from compositions which are easy to work and thereafter to convert the fibres to a different composition by leaching out at least some of the fluxes used in melting the glass. The inventor has found that it is desirable to perform the leaching operation after the fibers have been woven or otherwise formed into the desired articles.

The patent gives four examples quite in detail as to the method of carrying out this invention but a brief statement of the invention is presumably found in claim one which is as follows: An article comprising glass fibres which have a diameter less than .001 inch and which consist approximately of 90.5% SiO_2, 3.5% Al_2O_3, 2.7% CaO, .7% MgO, and 2.5% B_2O_3 the fibres being porous.

The following references are of record in the file of this patent: United States Patents: 2,106,744, Hood et al., Feb. 1, 1938; 2,252,466, Hanlein, Aug. 12, 1941; and 2,286,275, Hood et al., June 16, 1942.

Tube and Cane Machines

General Electric Tube Coiling Machine. Fig. 4. Patent No. 2,491,857. Alfred Greiner assigned this invention to General Electric Company. The purpose of the machine is to bend a length of tubing or rod into a spiral or helix such as is shown in the figure.

The machine includes a heating oven where the tube is supported on rollers and heated to the softening point. The tube is then dropped quickly into position to be engaged by a circular form having helical grooves corresponding to the form to be given to the coil. The outside of the tube is formed by grooved rollers which guide it into the grooves in the form. After the glass has set, it is unscrewed from the form in the shape shown in the figure. A characteristic of the invention is that the machine engages the tube, is engaged by the form at its midsection and then both ends are bent around the form to make a double helix.

The references cited by the Patent Office were Patents No. 15,899 to Perkins et al., dated Oct. 14, 1856 and 996,802 to Schneider, dated July 4, 1911.

Machine for Making Circular Fluorescent Lamps. Fig. 5. Patent No. 2,492,904. Sylvania Electric Products Inc., acquired this invention from Ralph B. Thomas and Gerald S. Quinn. A piece of glass tube of the de-

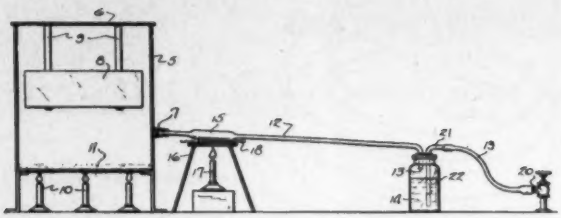


Fig. 6. Method of Reducing Reflection from Glass Surfaces.

sired length is made in a helical form so that one end is above the other which permits access to the ends for the application of the terminals. A jig is provided by which the helical tube is brought into a plane to form a circle.

Clamps are provided for holding the helical tube 2 in position on a base 1, the inner surface of the tube having been previously coated with luminescent material. Two levers are provided, one of which holds one end of the helix against the base while the other rests on the elevated end. The assembly is then placed in a heating chamber until the glass has softened when the weight of the upper lever will cause the elevated end of the tube to be depressed so that the two ends are in alignment. The figure shows one end elevated before the bending operation.

The only reference cited by the Patent Office was German Patent No. 539,291 dated Nov. 24, 1931.

Miscellaneous Processes

Method of Reducing Reflection from Glass Surfaces. Fig. 6. Patent No. 2,490,263. Romey A. Gaiser and Milton F. Schaible assigned this invention to Libbey-Owens-Ford Glass Company. Reduced reflection is of value in many forms of glass used for light transmission and especially in double glazed windows such as used in airplanes where there are four reflecting surfaces in each window.

The drawing shows an iron tank 5 having a cover and an inlet 7 near the bottom for the admission of gas used in treating the sheets 8. The tank is heated by burners 10. The bottom of the tank contains a layer of sodium silicofluoride 11. Air is supplied from a valve 20 to a wash bottle 22 containing sulfuric acid which removes the excess moisture. This air is then heated by a burner 17.

In the use of this apparatus, the glass is first heated to about 125°C. The heating of the sodium fluosilicate produces vapors which attack the glass and produce a low reflecting film on the surface after about five minutes. The patent gives full directions for using this method.

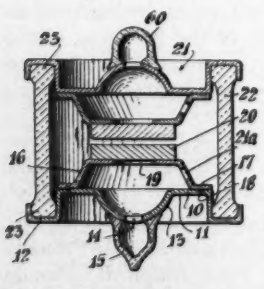


Fig. 7. Spark Gap.

The Patent Office cited 17 U. S. patents during the prosecution of the application and also two foreign patents and four publications

Spark Gap. Fig. 7. Patent No. 2,491,631. This invention by Alexander C. Wall and Herbert E. Oles was assigned to P. R. Mallory & Co., Inc., Indianapolis, Ind. The patent discloses a method of making a particular spark gap as shown in Patents No. 2,459,855 and 2,354,786 granted to A. C. Wall.

The figure is a section through a spark gap greatly enlarged. The particular feature of possible interest to the glass business is the method by which the glass spacer tube 22 is manipulated so as to position two contacts 20 which are closely spaced and which must be exactly parallel. The machine provides means by which the spacer tube is heated to the softening point and a dial indicator shows the space between the contacts. This involves several glass-to-metal seals. The mechanism described in the patent is designed for the purpose of making the several glass-to-metal seals and securing the proper positioning of the contacts 20.

The following references are of record in the file of this patent: United States Patents: 362,789, Sawyer, May 5, 1887; 405,124, Schmid, June 11, 1889; 876,899, Crandall, Jan. 14, 1908; 1,281,309, Dubilier, Oct. 15, 1918; 1,452,275, Housekeeper, Apr. 17, 1923; 2,177,502, Stack, Oct. 24, 1939; 2,222,093, Swanson, Nov. 19, 1940; 2,297,492, Michaelis, Sept. 29, 1942; 2,304,927, Kane, Dec. 15, 1942; and 2,402,119, Beggs, June 18, 1946.

Ampul Sealing Machine. Fig. 8. Patent No. 2,491,762. Andrew F. Piszel of North Arlington, N. J., obtained this patent.

The ampuls 22 are seated in openings in a circular table 16 which is continuously driven by a motor 8. As the ampuls pass along, the tops are subjected to heat from a row of burners after which they pass to the pinching or sealing rolls 56 and 57 which are driven by the same motor. This closes the open ends of the ampuls which may be removed from the table as soon as they are cool. Various adjustments are provided to adapt the machine to operate upon ampuls of different sizes.

The following references are of record in the file of this patent: 2,168,509, Bennett, Aug. 8, 1939; 2,258,408, Cozzoli, Oct. 10, 1941; 2,266,417, Eisler, Dec. 16, 1941; and 2,270,152, Themak, Jan. 13, 1942.

Fluorescent Lamp Machine. Fig. 9. Patent No. 2,491,848. This is an English invention made by Messrs. Breadner, Simms and Harris who assigned the U. S. patent to General Electric Company. A corresponding application has been filed in Great Britain.

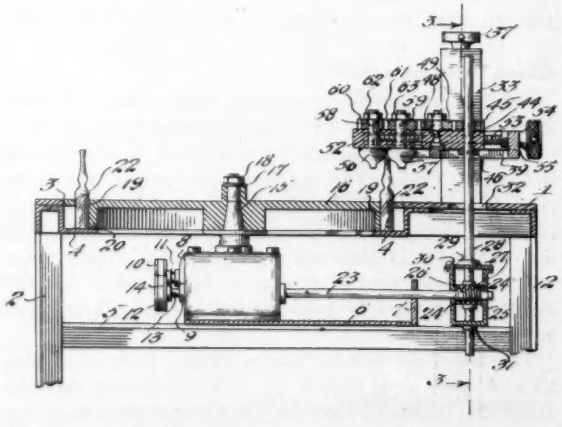
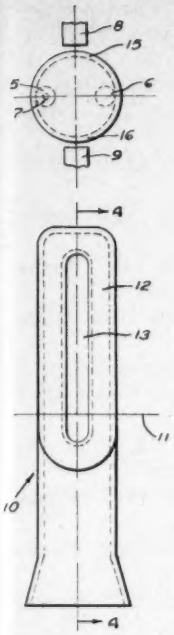


Fig. 8. Ampul Sealing Machine.



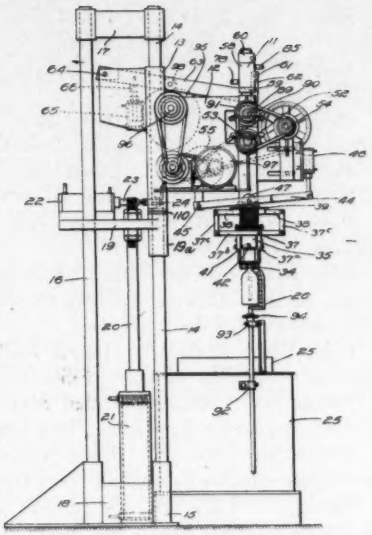


Fig. 9. Fluorescent Lamp Machine. **Fig. 10. Hartford Tempering Machine.**

The upper part of the figure shows a cylindrical tube placed between jaws 8 and 9 and when the tube is heated to the softening point, these jaws press the sides 15 and 16 into contact about two mandrels 5 and 6 which have been moved up inside the tube. This forms a central partition 13 leaving a U-shaped tube 12. The blank is cut off at the line 11, the inside coated with fluorescent powder and suitable electrodes are sealed into the open ends. It will be observed that the jaws do not extend to the top of the original tube so that a connection is left across the top.

The following references are of record in the file of this patent: United States Patents: 1,867,154, Hotchner, July 12, 1932; 1,974,888, Barclay, Sept. 25, 1934; 2,102,049, Warren, Dec. 14, 1937; 2,102,189, Barclay, Dec. 14, 1937; and 2,204,542, Anastor, June 18, 1940. Foreign Patents: 410,055, Great Britain, May 10, 1934 and 604,720, Germany, Oct. 26, 1934.

Hartford Tempering Machine. Fig. 10. Patent No. 2,492,216. Thomas D. Green assigned this invention to Hartford-Empire Company. The machine is designed for tempering bottles or similar containers by jets of cooling fluid applied both to the inside and outside, these jets varying at different points in accordance with the thickness of the glass at different parts of the bottle.

The drawing shows a tongs mechanism which grips the finish of the bottle while the bottle or the cooling nozzles are rotated. The tongs are arranged to lift the bottle from a heating furnace 25 into the position shown in the drawing where an internal cooling nozzle projects inside the bottle and an external cooler 26 applies cooling fluid to the outside. An exhaust device withdraws the cooling fluid from the inside of the bottle.

The patent contains 23 claims and 13 U. S. and foreign patents were cited by the Patent Office during the prosecution of the application. The references were: United States Patents: 846,211, Johnson, Mar. 5, 1907; 1,854,471, Hofmann, Apr. 19, 1932; 1,869,920, Soubier, Aug. 2, 1932; 2,054,595, Clitherow, Sept. 15, 1936; 2,066,283, Wadman, Dec. 29, 1936; 2,123,145, Peiler, July 5, 1938; 2,180,737, Hess, Nov. 21, 1939; 2,198,749, Weber, Apr. 30, 1940; 2,302,078, Wadman, Nov. 17, 1942; and 2,375,944, Quentin, May 15, 1945. Foreign Patents: 371,090, Italy, May 11, 1939; 469,994, Great Britain, Aug. 3, 1937; and 482,914, Great Britain, Apr. 7, 1938.

Glass Coated Silicon Steel. Patent No. 2,492,682. This invention by Victor W. Carpenter and Samuel A. Bell of Middletown, Ohio, was assigned to Armco Steel Corporation. The process is an improvement over that set out in Patent No. 2,385,332 granted to these inventors and Joseph E. Heck.

Claim 1 of the patent is as follows: A process of producing silicon steel sheet or strip stock with insulative coating of glasslike character, which comprises imposing upon the surfaces of silicon steel stock a metallic hydroxide chosen from the class consisting of magnesium hydroxide and calcium hydroxide, capable of dehydrating to an oxide which acts as an annealing separator, and which also will combine with silica to form a glasslike substance, passing the coated stock through a continuous furnace and heat treating it at temperatures between substantially 1500 and substantially 1650° F. in a moisture containing hydrogen bearing atmosphere nonoxidizing to iron, whereby to dehydrate the hydroxide, to decarburize the silicon steel stock and to oxidize silicon at and below the surfaces thereof to silica, afterward box annealing the stock so treated at temperatures of around 2100° F. in a dry reducing atmosphere to cause migration of silica to the surfaces of the stock and to fusion of silica thereat with part of said oxide to form a glassy coating next said surfaces, with a remainder of uncombined oxide sufficient to act as an annealing separator.

The following references are of record in the file of this patent: United States Patents: 1,869,025, Seastone, July 26, 1932; 2,050,408, Yensen, Aug. 11, 1936; 2,354,123, Horstman et al., July 18, 1944; and 2,394,047, Elsey et al., Feb. 5, 1946.

Ampul Sealing Machine. Fig. 11. Patent No. 2,493,070. James F. Kahlenberg and Herman H. Kahlenberg of Sarasota, Fla., made this invention. The inventors claim to have produced a simple and cheap machine which is entirely under the control of the operator and

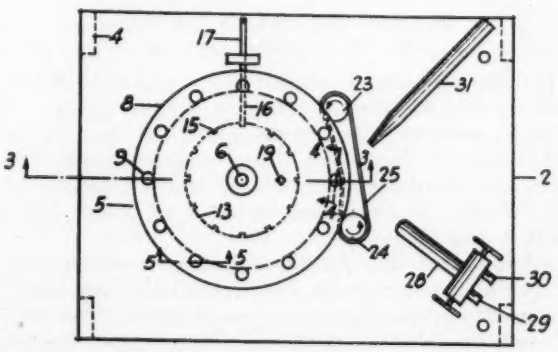


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Fig. 11. Ampul Sealing Machine.

which is adapted in laboratories which can not afford the high priced machines previously offered.

As shown in the figure, the machine comprises a table 2 supporting a rotatable carrier 5 having holes 9 to receive the ampuls. These are supported by a lower disk arranged so as to support the ampuls at a slight angle instead of vertically. The table is rotated by pulleys 23 and 24 which drive a belt 25 engaging the ampuls so as to rotate them and also to rotate the table. A gas burner 28 is provided to heat the ampuls while an air blast from a nozzle 31 is directed toward the lower part of the ampuls.

A handle 17 is provided to lock the table from rotation. When the operator sees that the neck of an ampul has been sufficiently heated, he grasps the top of the ampul by the usual grippers and holds it while the ampul rotates, thus sealing the neck.

The following references are of record in the file of this patent: United States Patents: 1,862,821, Henderson, June 14, 1932; 1,967,766, DeLano, July 24, 1934; 2,051,764, Erdmann et al., Aug. 18, 1936; and 2,168,509, Bennett, Aug. 8, 1939.

Sheet and Plate Glass

The American Bicheroux Company has dedicated the following six patents to the people of the United States for their free use. A little further information is published in the Patent office Gazette dated Dec. 20, 1949:

Patent No. 1,928,254. Dated Sept. 26, 1933. Apparatus for Annealing Continuous Sheets of Glass.

Patent No. 1,931,628. Dated Oct. 24, 1933. Apparatus for Conveying Glass Sheets.

Patent No. 1,967,613. Dated July 24, 1934. Lehring Glass Sheets.

Patent No. 1,967,638. Dated July 24, 1934. Feeding Glass Sheets from the Forming Machines.

Patent No. 1,988,892. Dated Jan. 22, 1935. Method of and Apparatus for Handling Glass Sheets.

Patent No. 2,048,830. Dated July 28, 1936. Manufacture of Glass Sheets.

Libbey-Owens-Ford Glass Company has dedicated all rights to the following five patents to the people of the United States for their free use:

Patent No. 1,904,978. Dated April 18, 1933. Apparatus for the Manufacture of Sheet Glass.

Patent No. 1,906,249. Dated May 2, 1933. Process and Apparatus for Producing Sheet Glass.

Patent No. 1,928,371. Dated Sept. 26, 1933. Process and Apparatus for Producing Sheet Glass.

Patent No. 1,937,380. Dated Nov. 28, 1933. Process and Apparatus for Producing Sheet Glass.

Patent No. 1,948,563. Dated Feb. 27, 1934. Apparatus for Producing Sheet Glass.

Left to right: Ray Conyers, Max Hawkins, Edward Conley, Arthur Sanzo, C. P. Overmyer, Harold Ryan, Joseph Sanzo and Frank Bitzer. Charles Cox was not present.

OVERMYER MOULD HONORS 25-YEAR EMPLOYEES

The Overmyer Mould Company honored its eight 25-year men with a banquet at which gold watches, in token of loyalty and service, were presented. Those receiving the gold watches were Frank Bitzer, Edward Conley, Ray Conyers, Charles Cox (Overmyer Mould Company of California), Max Hawkins, Harold Ryan, Joseph Sanzo and Arthur Sanzo.

At the same time the company chose the occasion to honor the young men who have finished their apprenticeship and are now journeymen mouldmakers. The journeymen receiving recognition were Glen Daggett, Stanley Edwards, Clarence Fast, Jr., Lawrence Fouse, William Giger, Donald Horn, Richard Pringry and Wayne Rouch.

C. P. Overmyer, President of Overmyer Industries, made the presentation address paying tribute to the 25-year men and expressing the company's gratitude for their years of loyalty, hard work and usefulness to the firm. Lowell Roesner, company executive, acted as master of ceremonies.

CORNING NAMES MANAGER AND SUPERINTENDENT FOR NEW PILOT PLANT

Dr. H. R. Kiehl, a member of Corning Glass Works' research staff for sixteen years, has been appointed Manager of the company's new Pilot Plant. George F. Williams was named Production Superintendent of the new plant, which will be known as the No. 2 Pilot Plant.

Dr. Kiehl's most recent position with Corning was that of liaison man between the company's technology and production groups. He joined the firm in 1934 as a research physicist following his graduation from Pennsylvania State College. Dr. Kiehl's work has been concerned with laboratory problems from that time until his appointment to the position he vacated at the time of his present promotion.

Mr. Williams, formerly superintendent of Pyrex Finishing at the company's Main Plant, began his association with Corning in 1931 as a control chemist at the Central Falls, Rhode Island, plant. In 1934, he was transferred to Fall Brook as assistant to the Plant Manager. In 1939, Mr. Williams joined the staff of Corning's Glass Technology Department, where he remained until his promotion with the Pyrex Finishing department in 1945.

• Selas Corporation of America has announced that its Chicago office has been moved and is now located at 3857 W. Washington Boulevard.

L-O-F AND PITTSBURGH PLATE SIGN AGREEMENT WITH UNION

A new retirement and disability pension plan, plus increased health, accident and hospital insurance allowances for 18,500 employees in the flat glass industry, was agreed to after nine days' negotiations between the Pittsburgh Plate Glass Company, Libbey-Owens-Ford-Glass Company and the Federation of Glass, Ceramic & Silica Sand Workers of America, CIO.

The more important features of the new pension and welfare agreement governing hourly production workers of the CIO bargaining unit are as follows:

1. Pensions effective at age 65 range from $60 to $125 a month based on continuous service from 15 to 50 years. Monthly pension payments for continuous service up to 25 years are figured at $4 a month for each year and after 25 years of service at $1 a month per additional year. For example, a worker at age 65 who has 25 years of continuous service would be eligible for $100 a month pension.

2. An employee who becomes totally disabled after 15 years continuous service may have a pension, prior to reaching age 65, equal to three-fourths the retirement allowance, and then his benefits would be refigured at age 65.

3. Eligibility for old age retirement benefits is retroactive to May 1, 1949. Due to the test nature of the plan, the company is committed to it for two years and the union for a five-year period.

4. In calculating "continuous service" no break occurs if an employee returns from a layoff or leave within five years. For example, if a man was given a sick leave after age 60 and was unable to return to work, he would still be eligible for pension at age 65.

5. Only the primary benefits of the employee under Social Security Act are deductible from the company pension. Benefits which accrue to wife and children under Social Security do not apply.

6. Retirement at age 65 is not compulsory under the new plan.

7. Non-occupational health and accident insurance benefits are increased from $15 a week for 13 weeks to $26 a week for 26 weeks.

8. Hospitalization and surgical insurance is increased to allow each married employee up to $3 a month and each single worker up to $1.50 a month to apply on his local plan. Formerly these allowances were $2 and $1.

9. The present wage and working agreement was extended to May 15, 1951.

L. G. Bryan, Vice President of Libbey-Owens-Ford, who headed the negotiating delegation at Atlantic City, said the contract provisions round out a complete welfare plan for the company which started several years ago with group insurance coverage. Nearly two years of study preceded the current negotiations.

Mr. David G. Hill, General Superintendent of Pittsburgh Plate Company's plate glass factories and who headed Pittsburgh negotiators, revealed that Pittsburgh Plate Glass has operated a voluntary pension plan for disabled and over-age hourly employees since 1907. He said that the company has also operated a contributory group life insurance program for glass plant hourly workers since 1925. This insurance program has been paid wholly by the company since 1948.

Several of the union leaders also expressed pleasure that several provisions which amplify the basic ideas of the steel and auto industry pension plans had been worked into the new flat glassworkers' pension plan.

Pittsburgh Plate plants affected are located at Creighton and Ford City, Pa., Mt. Vernon, Ohio; Clarksburg, W. Va., Henryetta, Okla., and Crystal City, Mo. Factories of Libbey-Owens-Ford are located at Toledo and Rossford, Ohio; Ottawa, Illinois; Charleston, West Virginia and Shreveport, Louisiana.

GLASS WORKERS AT CORNING SIGN NEW PACT

A contract that the American Flint Glass Workers Union, AFL, intends to use as a basis for negotiations with the national glass industry has been signed by the union and the Corning Glass Works.

Harry H. Cook, international President of the union, said the contract embodies the "best pension and general welfare plan that has yet been established in any major industry, including auto and steel."

The union's original demand for a 10-cent general wage increase was not granted but employees henceforth will get five paid holidays and double pay for holidays.

All employees, including those pensioned under the present company retirement plan, will at age 65 and after 25 years' service receive a minimum retirement income of $100 monthly. The sum includes social security benefits.

For the first time a pension provision for hospitalization benefits, life insurance and health and accident insurance was written into the contract. The firm henceforth will contribute to the improved hospitalization coverage, formerly paid for by employees alone.

OPTICAL SOCIETY WINTER MEETING

The Optical Society of America has announced that its Winter Meeting will be held on March 9, 10 and 11 at the Hotel Statler in New York City. The meeting will be open to non-members of the Society and all interested persons are invited to attend.

The annual meeting of the Inter-Society Color Council is being held at the Hotel Statler on March 8.

LECTURES PLANNED AT N. Y. STATE COLLEGE OF CERAMICS

Four outstanding authorities in ceramics, two from Europe, will lecture at the New York State College of Ceramics at Alfred University in the next four months as a part of the college's 50th anniversary celebration.

Dr. Norbert J. Kreidl, Director of chemical research for the Bausch & Lomb Optical Company, will speak at the University February 14 and 15 in an inauguration of the series. He will discuss atomic structure and the physical properties of glass.

Each of the men will give a popular lecture open to the public and will conduct a more technical seminar for graduate students and members of the college faculty. Other speakers in the lecture series, as announced by Dean John F. McMahon, include Dr. Martin J. Buerger, Professor of Mineralogy at M. I. T.; Professor Johann A. Hedvall of Chalmers University of Technology, Sweden; and Dr. Wilhelm Eithel, former Director of the Kaiser-Wilhelm Institute for Silicate Research, Berlin.

E. A. HILDRETH ELECTED PRESIDENT OF CANNING MACHINERY & SUPPLIES ASSOCIATION

Eugene A. Hildreth, Manager of the Market Development Department of Owens-Illinois Glass Company, was elected President of the Canning Machinery & Supplies Association. Mr. Hildreth, who has served as Vice President of the Association for the past two years, succeeds J. C. Whetzel of the Carnegie-Illinois Steel Corporation.

Mr. Hildreth entered the glass container business as a salesman in Chicago in 1919. After sales experience in the food industry, he left the glass business in 1928 to enter the public utility bond business in New York. He joined Owens-Illinois Glass Company in 1933 and has seen service as salesman in the New York branch, Manager of the Closure Sales, Liquor Ware and Food Industries Divisions. The Market Development Department, which he heads, carries forward sales promotion in the interest of products packaged in Duraglas containers.

DUNBAR SHIPS GLASSWARE BY AIR

Dunbar Glass Company recently became the country's first glass manufacturer to utilize air transport for a full cargo plane load of glassware, according to Henry E. Payne, President of the company.

The shipment was put aboard an Eastern Air Lines' DC-4 cargo liner in the Charleston, West Va. Airport. A large trailer truck was required to transport the glassware from the Dunbar plant to the Charleston Airport, from which it was flown to Miami Airport in Florida.

The shipment, comprising floral, table and novelty glassware, weighed 10,000 pounds and was valued at $15,000, according to Mr. Payne's announcement. Eastern Air Line officials said it is the largest air shipment of glassware on record.

ACHESON COLLOIDS ELECTS NEW OFFICERS

Acheson Colloids Corporation has announced the election of three new vice presidents. According to Howard A. Acheson, President of the firm, P. C. Buck became Vice President in charge of Production; M. W. Reynolds became Vice President in charge of Sales; and Raymond Szymanowitz, Vice President in charge of Research.

Messrs. Buck, Szymanowitz and Reynolds are all veterans of the Acheson organization, having been with the company for 30, 25 and 24 years respectively.

Mr. Reynolds and Mr. Buck will have their headquarters at the home office in Port Huron, Michigan, while Mr. Szymanowitz is located at the company's laboratories in Newark, New Jersey.

• R. D. Travers Company, Canadian representatives for the Cambridge Wire Cloth Company, has announced that they have moved to new and larger quarters at 117 Charlton Avenue, West Hamilton, Ontario.

PPG CANADIAN SUBSIDIARY IN PRODUCTION

The Canadian Industrial Glass Company's sheet window glass plant in St. Laurent, Que., expected to be in partial production by February 1, has scheduled capacity production for approximately May 1. The company is a new subsidiary of Pittsburgh Plate Glass. The plant was purchased last summer, having been converted at a cost estimated in excess of $500,000 from the Belgian "Fourcault" process to Pittsburgh's "Pennvernon" vertical flat draw process with two huge drawing machines.

The plant will produce at an estimated annual capacity between 40 and 50 million sq. ft. and this would be more than one-half of the current Canadian consumption, judging by imports which in 10 months of 1949 amounted to about 52.5 million sq. ft. For the present this will be Canada's only sheet window glass plant, but the British Pilkington Bros. Ltd. has recently organized a new Canadian subsidiary.

At the start only "single" and "double" strength glass will be produced but production of "heavy" sheet, weighing 42 oz. per sq. ft. and thickness 7/32 in., is scheduled to be started by the Canadian Industrial Glass Co. about May 1.

N. Y. METROPOLITAN SECTION OF A.C.S. HOLDS MEETING

The January meeting of the New York Metropolitan Section of the American Ceramic Society had as its speaker for the evening Dan Wheeler of Titanium Alloy Manufacturing Company. Mr. Wheeler presented a detailed resume of the history of the development of titanium and zirconium metals, oxides and salts. The highlight of this talk was the discussion and display of a collection of titanium gems showing a wide assortment of brilliant colors.

Also presented on the double-speaker program was Dr. R. J. Bondley of General Electric Company who spoke on metal-to-ceramic sealing techniques. Dr. Bondley exhibited many and varied sample seals.

Another double feature program is scheduled for February 24 at which V. H Remington of B. F. Drakenfeld & Co., Inc. will speak. His subject will be "A Review of Some Glass Decorating Methods." Second speaker for that evening will be T. G. O'Leary who will describe the new medium of photo-sensitive glass developed by Corning Glass Works.

Information is being sought of Albert Bronsther, on behalf of his wife, Esther, who since June 1946 has failed to receive any financial assistance and presently finds herself in need of aid. She is anxious to establish contact with her husband so that an arrangement can be made for her to receive regular support. Mr. Bronsther is about 72 years of age, born in Russia, is about 5 feet, 9 inches tall, weighs about 190 pounds, has dark hair and small blue eyes, and was a glassware worker. Anyone aware of this man's whereabouts is requested to communicate with the National Desertion Bureau, 105 Nassau Street, New York 7, N. Y.

GJ Research Digest

Some Observations on Density Changes, Their Measurement and Influence on the Quality of Container Glass

A progressive company producing glass containers by the means of automatic machines is continually striving not only to improve the quality, but also to increase still further the rates of production. The present day trend to still higher forming speeds and higher percentage packs makes it all the more important for one to keep the properties of the molten glass, particularly during melting, refining and conditioning, under a known degree of control. Closer control of the glass properties will assist the speed of production, raise the proportion of good ware, help the glass distribution in a particular bottle, enhance the overall appearance and assist the successful performance of the glass container in service. One approach to this phase of glass container production which has proven successful in practice is outlined by A. T. Coe in the August 1949 issue of the *Journal of the Society of Glass Technology*.

Many physical properties vary with composition and can be used for such studies. Each offers some advantages and a number of disadvantages. From Coe's study of the problem, he would in general recommend that due consideration be given to 1) density, 2) softening point by fiber extension and possibly 3) devitrification characteristics. In his own studies, he has used the two physical properties of density and strain caused by differential thermal expansion, i.e., due to the difference in chemical composition between cords and parent glass. Some use has also been made of a third property of chemical durability determined by alkali extraction.

Density was chosen as the main criterion for glass control since it can be determined with very high accuracy in a relatively short time on large numbers of samples by a worker with but moderate skill. Table I gives an idea of the relative effects on the density, chemical durability and thermal expansion of a soda-lime-silica container glass of different glass forming oxides.

TABLE I.*

Density	Chemical Durability	Thermal Expansion
$CaO+$	Na_2O-	Na_2O+
SiO_2-	Al_2O_3+	SiO_2-
Na_2O+	SiO_2+	Al_2O_3-
Al_2O_3+	$CaO-$	$CaO+$

*The oxides are arranged in decreasing order of the numerical effect they exert.
+ indicates an increase in the numerical value.
— indicates a decrease.

By selecting two separate physical properties which can be measured accurately and quickly and are specific in their response to, say, CaO and to Na_2O, it should not be unduly different to translate variations in these physical properties to constituent oxides and thus to the batch changes which may be needed to correct some abnormal condition of the glass.

For routine tests, samples are taken regularly from each machine in order to derive an accurate picture of the overall distribution of density of the glass in each furnace. It is considered that larger variations in density may arise from the preparation of rods than by using commercially annealed glassware. Therefore, commercially annealed glassware taken from the delivery end of the lehr is favored as test samples. Ring sections are prepared and the samples for density taken from various locations in the rings. If the ring section shows inhomogeneity, care must be taken to include the cord areas. The densities are measured by the means of a "sink-float" technique and apparatus.

Table II indicates how observed changes in density, chemical durability and type of cord strain may be interpreted.

TABLE II.

Increasing Density			Decreasing Density		
Durability markedly improving and cords in compression	Durability slightly deteriorating and cords in tension	Durability markedly deteriorating and cords in strong tension	Durability markedly improving and cords in strong compression	Durability slightly improving and cords in compression	Durability markedly deteriorating and cords in tension
Increase in LIME Decrease in SODA	Increase in LIME Decrease in SILICA	Increase in SODA Decrease in SILICA	Increase in SILICA Decrease in SODA	Increase in SILICA Decrease in LIME	Increase in SODA Decrease in LIME

Besides indicating the variation of density with time, the routine measurements also show the spread of density at any one machine at a given furnace. This spread of density gives a useful indication of impending changes in glass composition and in the homogeneity of the glass. An increase in the density spread shows, of course, that streams of glass differing in chemical composition are flowing to different machines.

The increase of density spread may be affected by some or all of the following factors: 1) increased glass load (machine pull) bringing a greater volume of "live" glass into circulation; 2) higher temperatures in the furnace, again increasing the depth of "live" glass; 3) differences in chemical composition arising from intentional batch changes and resulting in a new glass having slightly different properties from the glass already in circulation in the furnace; 4) differences in glass composition arising from incorrect proportioning of batch, or from poor mixing of the batch or from segregation of the batch in handling after mixing and consequent selective volatilization; 5) the color and diathermancy of the glass being melted. Colored glasses present certain difficulties which are not shown by colorless glass. Dark-green glasses are probably more difficult to keep homogeneous than amber.

Both the first and second factors result in the disturbance of previously quiescent layers of heavier glass in the lower parts of the tank resulting in an increased spread of density rather than in a change of the mean level of density.

(*Continued on page* 109)

INVESTIGATION OF ALLEGED CANADIAN FLAT GLASS COMBINE BEING STUDIED

A report alleging that an illegal combine "detrimental to the public interest" exists among jobbers of flat glass in Ontario and Quebec has been made to the Canadian Government by F. A. McGregor, Combines Commissioner. Justice Minister Stuart Garson stated that as soon as he has studied the report, as well as legal opinion, he would announce whether legal proceedings would be instituted against the members of this alleged combine.

In a 32,000-word report, the Commissioner named the following nine companies and the Secretary of a Trade Association as parties to this alleged combine in the wholesaling and installing of plate glass, window glass and other types of flat glass: Consolidated Glass Ltd., Toronto; Hobbs Glass Ltd., London; Pilkington Brothers Canada Ltd., Toronto; Advance Glass and Mirror Co., Ltd., Toronto; Canadian Plate and Window Glass Ltd., Toronto; Excelsior Plate Glass Co., Ltd., Toronto; Lloyd's Glass Co., Hamilton; J. P. Shea & Co., Ltd., Montreal, and Queen City Glass Ltd., Toronto. W. O. Matthews, Toronto, is the Association Secretary named in the report.

The charge is the outcome of an investigation which was started as far back as 1947. It is alleged that the Association members have unduly lessened competition in the glass jobbing trade by agreement upon prices and conditions of sale and have operated a registration scheme which results in the submission of identical bids by them when tenders are called.

The jobbers' association has headquarters in Toronto and Montreal, with Mr. Matthews reportedly its Secretary since it was formed in 1928, the year the Combines Commissioner alleges the firms involved began fixing prices on all types of flat glass.

An international cartel had an effect on the glass situation in Canada, the Combines Commissioner found, declaring that for a time supplies were withheld from most non-members of the association and when they did get imported glass later, they were charged as much as 20% more than the association members. The report also indicated association members during the years had been able to maintain substantial control over available supplies of glass imported from the United States, Belgium and Czechoslovakia because of international cartel agreements, their own "restrictive" practices and the selling policies of Canadian agents of foreign manufacturers. Conditions applying in international trade in glass are of particular importance to Canada, the report added, because of this country's dependence on imported supplies.

The Commissioner found the international cartel among foreign manufacturers operated to fix prices and share the markets of the world until the war cut off European shipments to Canada. Under a 1935 agreement, the Canadian market had been shared equally by three plate-glass manufacturing groups in Britain, Europe and the United States.

• R. W. Brown has been appointed Eastern Division Advertising Manager of the Colorado Fuel and Iron Corporation with headquarters in Denver, Colorado. Mr. Brown will continue to supervise the Wickwire Division product groups and American Wire Fabrics Corporation products.

AGA BOARD OF GOVERNORS ELECTS OFFICERS

The recently elected Board of Governors of the American Glassware Association recently announced the election of officers for 1950. Elected Chairman of the Board was Carl W. Gustkey, President of Imperial Glass Corporation; Business Manager, Stevenson, Jordon & Harrison, Inc. of New York City; and Secretary and Treasurer, H. L. Dillingham, on the staff of Stevenson, Jordan & Harrison, Inc.

Calvin B. Roe, retired President of Fostoria Glass Company, would not consider re-election to the office of Chairman of the Board which he has held for many years.

Chairmen elected to the Association's various committees are as follows: *Traffic Committee*: H. S. McCafferty of Federal Glass Company; *Foreign Trade Committee*: C. W. Gustkey; *Import Committee*: C. W. Carlson, President of United States Glass Company; *Export Committee*: C. C. Stein, Sales Manager of Federal Glass Company; *Membership Committee*: C. B. Roe; and *Public and Government Relations Committee*: John H. Wright, Retired Vice President of Owens-Illinois Glass Company.

BALL BROTHERS APPOINTMENT

The advancement of Walter E. Black to Assistant Director of Industrial Relations has been announced by Ball Brothers Company. Mr. Black has been associated with the firm since 1946 and for the last year has been a member of the staff of V. J. Cox, Director of Industrial Relations.

Joining Ball Brothers as a management trainee, Mr. Black was assigned to the post of assistant superintendent of plant service and maintenance following his period of training. He was with that division for a little more than a year, during which time he rose to the superintendency of all maintenance work under the supervision of Plant Engineer C. H. Bush. He was transferred to Industrial Relations late in 1948.

PILKINGTON BROTHERS APPOINTMENTS

Donald H. Jupp, a Director of the company, has been appointed Assistant General Manager of Pilkington Brothers (Canada) Limited and Gordon S. Hull will replace him in his previous position as Glass Sales Manager.

Mr. Jupp, who is a graduate of Cambridge University, joined Pilkington Brothers Limited, England, in 1933 and after serving in various capacities in the British market, he was transferred to the Canadian company in 1935 to occupy an executive position in the Sales Department. He was appointed Glass Sales Manager in 1946.

Mr. Hull, who joined Pilkington in 1927, served in the Ontario Sales Organization until 1936 when he was appointed Manager and subsequently Director of Vitrolite Limited, a subsidiary company of Pilkington Brothers (Canada) Limited. In addition to these duties, he assumed the post of Specialty Sales Manager in 1947 and for the past 18 months has been Acting Glass Sales Manager during Mr. Jupp's absence in England where he was acting as Export Sales Manager for the parent company.

CORRECTION: In the January issue of THE GLASS INDUSTRY it was reported that Pilkington Brothers Limited is planning to erect a plant for the manufacture of sheet glass at St. Helens, England. However, the plant to be erected will be located on the outskirts of Toronto, Canada.

CURRENT STATISTICAL POSITION OF GLASS

Employment and payrolls: During the month of November 1949, employment in the glass industry was reported to be 107,700. This is slightly more than the revised employment figure of 107,500 for October.

The preliminary payrolls figure for November 1949, $28,247,208, indicated an increase of close to 8 per cent over the previous month's revised payrolls of $26,232,400.

Glass container production for the month of December 1949, based on figures released by the Bureau of Census, fell off about 5½ per cent to reach 6,932,178 gross. During December 1948, production had been 6,764,567 gross, which is close to 2½ per cent below December 1949. The preliminary total glass container production figure for the year 1949 is 90,754,890 gross. This indicates that glass container production for 1949 was 8 per cent off from the total production of 98,678,857 gross at the close of 1948.

Glass container shipments for December 1949 were 6,529,752 gross. This is about 9 per cent below the 7,196,984 gross shipped during November. Shipments during December 1948 were 6,302,671 gross, which is 3½ per cent less than for December 1949. At the close of 1949, shipments had reached 89,673,754 gross. As compared with 1948 shipments of 97,332,944 gross, the 1949 preliminary total is a little more than 7½ per cent less than for 1948.

Stocks on hand at the close of December 1949 are 9,039,483 gross. This is a little higher than the 8,680,951 gross on hand at the close of November and the 8,752,662 gross on hand at the close of December 1948.

Automatic tumbler production for the month of December 1949 was 4,853,123 dozens. This is close to 2 per cent less than for November production which was 4,939,817 dozens. During December 1948, production was 4,834,520. Shipments for December fell off considerably to reach 3,755,665 dozens. This is 24 per cent less than the 4,961,121 dozens shipped during the month of November. Shipments during December 1948 were 4,346,962 dozens. Stocks on hand at the close of December 1949 were 8,584,075 dozens, as compared with 7,614,621 dozens on hand at the close of November and 8,245,303 dozens on hand at the close of December 1948.

Table, kitchen and household: Manufacturers' sales of machine-made table, kitchen and household glassware for December 1949 was 28 per cent below that of the previous month. December sales were 2,616,841 dozens as compared with November sales of 3,647,448 dozens. Sales during December 1948 were 2,785,439 dozens. Total manufacturers' sales for 1949 were 39,257,870 dozens. This is 4 per cent less than the 41,047,322 dozens sold during 1948.

GLASS CONTAINER SHIPMENTS

(All figures in Gross)

	December 1949
Narrow Neck Containers	
Foods	522,286
Medicinal & Health Supplies	1,034,670
Chemicals, Household & Industrial	368,146
Beverages, Returnable	*227,649
Beverages, Non-returnable	.....
Beer, Returnable	128,708
Beer, Non-returnable	204,250
Liquors	639,176
Wines	328,338
Toiletries & Cosmetics	439,421
Sub-total (Narrow)	3,892,644
Wide Mouth Containers	
Foods	†1,627,420
Dairy Products	304,059
Home Canning	.....
Medicinal & Health Supplies	233,038
Chemicals, Household & Industrial	75,666
Toiletries & Cosmetics	116,181
Packers' Tumblers	73,116
Sub-total (Wide)	2,429,480
Total Domestic	6,322,124
Export Shipments	207,628
Total Shipments	6,529,752

* This figure includes Beverages, Non-returnable.
† This figure includes Home Canning.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All figures in Gross)

		December Production 1949	December Stocks 1949
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	2,699,286	3,274,835
	Wide Mouth	*2,245,810	2,458,301
Dairy Products		307,912	247,257
Home Canning		.....	398,996
Beverages, Returnable		†311,395	706,329
Beverages, Non-returnable		.....	10,064
Beer, Returnable		128,480	533,642
Beer, Non-returnable		210,817	283,614
Liquors		614,496	700,494
Wines		360,730	313,349
Packers' Tumblers		84,252	112,602
Total		6,963,178	9,039,483

* This figure includes Home Canning.
† This figure includes Beverages, Non-returnable.

NEW GRADUATE PROGRAM AT NEWARK COLLEGE OF ENGINEERING

As part of the new graduate program of the Newark College of Engineering, a coordinated course on Materials of Engineering Construction will be given. Attendance at this course is required for all candidates for the Master's degree in Chemical, Electrical, Mechanical and Civil Engineering.

Included in the list of lecture topics is Glass, Structural; Glass, Silica and Quartz, Process Applications; and Refractories for Medium and High Temperatures.

• Albert Kellner, Export Manager for Pemco Corporation, was re-elected a Director of the Baltimore Foreign Trade Forum for the second consecutive year.

BALL BROTHERS NAMES SALES MANAGER

The appointment of Earl A. Sheffield as Sales Manager, Domestic Products Division, for the Ball Brothers glass container manufacturing firm has been announced.

Mr. Sheffield succeeded Frank E. Burt, who retired the first of the year after a 55-year association with Ball. Mr. Burt had been Sales Manager for the Domestic Products Division for 39 years. It was he who organized the first Ball fruit jar sales organization as a separate division in 1911.

Mr. Sheffield succeeded Frank E. Burt, who retired the first of the year after a 55-year association with Ball. Mr. Burt had been Sales Manager for the Domestic Products Division for 39 years. It was he who organized the first Ball fruit jar sales organization as a separate division back in 1911.

Mr. Sheffield will be in charge of sales and promotions of fruit jars, freezer jars and other supplies which Ball manufactures for home canners. He will serve under the direction of G. Fred Rieman, who became Director in charge of all Ball sales last October.

Associated with Ball Brothers since 1922, Mr. Sheffield served as the division's assistant sales manager from 1946 until a year ago. Early last year, he was named Sales Promotion Manager.

VITRO BUYS PIGMENT FIRM

The Vitro Manufacturing Company has announced the purchase of the assets and business of Forche & Smith, Falls Creek, Pa., manufacturers of iron oxides. The newly-acquired firm will operate as a wholly-owned subsidiary of Vitro and will be known as the Vitro Pigments, Inc. Henry Forche, former partner, will remain in charge of production.

As part of The Vitro Manufacturing Company, the operations of Forche & Smith will be continued and expanded. Plans call for the modernization of the present physical plant, which has 25,000 square feet of floor space, and the installation of new equipment for the production of other chemicals and pigments, in addition to the iron oxides now being made.

The purchase of these facilities will enable Vitro to augment its present line of colors and chemicals for the glass, ceramic, porcelain enamel and plastic industries.

A.C.S. STUDENT BRANCH HOLDS MEETING

Dr. C. L. Thompson, Laboratory Manager of Harbison-Walker Refractories Company, spoke before the Student Branch of the American Ceramic Society which had convened at the University of Illinois, Department of Ceramic Engineering.

Dr. Thompson spoke on "The Application of Ceramic Chemistry to Research in Refractories", a talk which pointed out to the students some applications of high-temperature chemistry and phase rule in ceramic research.

ECONOMIES

BORAX... the economies of a B_2O_3 addition should not be measured solely by the cost of the raw material but by an evaluation of the improvements and beneficial effects resulting from its use.

Our representatives are prepared to discuss all the special advantages of B_2O_3 in glass.

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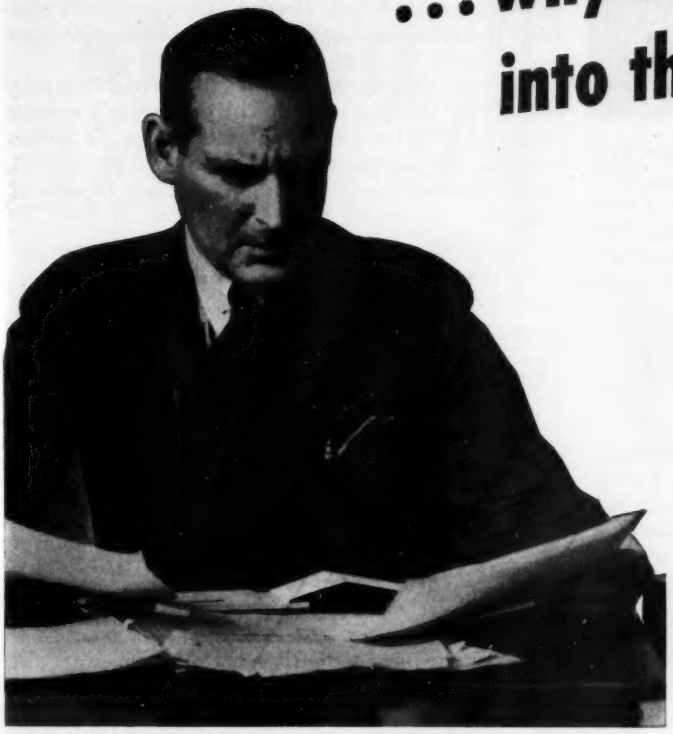

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REGENERATIVE FURNACE CONTROL

That's what you'll ask after you have had the facts.

For instance, in the Morgan-Isley System the draft is unlimited, positive, mechanically produced and regulated with extreme accuracy. There is no loss of draft through leaky reversing valves.

In addition, the Morgan-Isley makes possible a secondary regenerator that increases the flame temperature from 200° to 400° F. and returns about 15% more B. t. u. to the furnace. A real, fuel saving is obtained on this basis alone.

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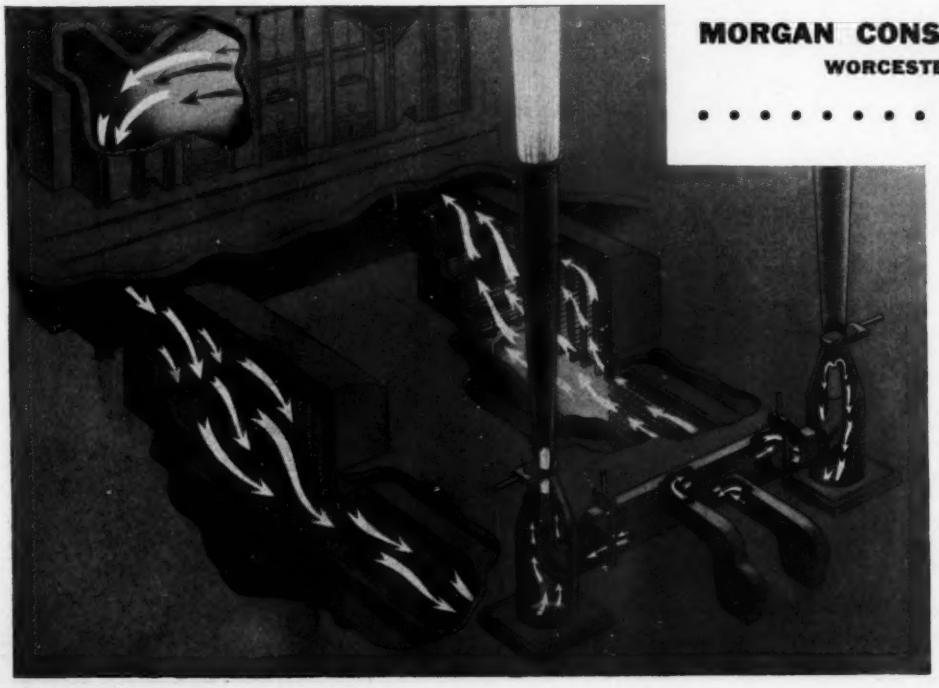

MORGAN CONSTRUCTION CO.
WORCESTER, MASS.

CCC-2i

• R. Graham Bailey of British Hartford Fairmount Syndicate, Ltd., London, England, European representatives of Lynch Corporation, visits with T. C. Werbe, Lynch Chairman of the Board (center) and A. G. Doll, Vice President (left). A sales and planning conference was held at the firm's offices to discuss the European glass machinery markets.

WHEELCO SIGNS LICENSING AGREEMENT

The Wheelco Instruments Company has announced that it recently signed a licensing agreement with a French instrument manufacturer. The Wheelco Capacitrol, electronic controller, will be manufactured by La Pyrometrie Industrielle, Paris, and the Flame-otrol, combustion safeguard, by their subsidiary Le Controle de Chauffe, Bagneux, France.

Terms of the license permit the distribution of these two Wheelco instruments in France, Spain and Portugal.

NORTON ELECTS VICE PRESIDENT

Milton F. Beecher has been elected Vice President in charge of Research and Development by the Norton Company at its 64th Annual Meeting. Directors of the company re-elected George N. Jeppson as Board Chairman and Milton P. Higgins as President.

Formerly Director of Research at Norton Company since 1941, Mr. Beecher entered the company's ceramic section in 1915, becoming chief of the section the following year. He was appointed research engineer in 1919, holding the same position until he was made Director of Research.

RECTANGULAR VIDEO BULB OUTPUT INCREASED BY O-I SUBSIDIARY

Seventy-five per cent of the television bulb production capacity of American Structural Products Co. will be devoted to the new all-glass rectangular bulb by the end of March, Stanley J. McGiveran, President, has announced.

Increased production for the rectangular bulb, introduced late in 1949, is necessary to fill present orders, Mr. McGiveran said. Demand will necessitate the company's devoting 33 per cent of capacity in January to 16-inch bulbs and the 14-inch size will go into mass production next month. Both sizes will account for 50 per cent of total output in February.

• Faustin J. Solon, Vice President of the Owens-Illinois Glass Co., was toastmaster at the recent 56th annual dinner meeting of the Toledo Chamber of Commerce.

IN CINCINNATI *Wherever you go...Whatever you see...* *is in the picture!*

Cincinnati in Today's Picture: This thriving American city on the Ohio River is known as "The Queen City of the West." The greatest wine producing center of this country during the 70's and 80's, and the country's pork-packing center of the nineteenth century, Cincinnati today claims to make more machine tools, playing cards and soap than any city in the world. Its city-manager form of government claims to keep its taxes lowest of any U.S. city.

Banner Lime plays a prominent part in Cincinnati's picture—In downtown Cincinnati and on its seven hills stand many buildings in which Banner lime was used for plastering. Among the more recent buildings are the beautiful Valley Shop-in Center in Roselawn, the new McMicken Hall, University of Cincinnati and the Terrace Plaza Building. Banner Lime is also used extensively by the farmers and market gardeners around Cincinnati to produce better quality foods. Industrial uses include waste treating and sanitation measures in breweries, milk plants, etc.

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Glassmen everywhere agree that one of the most important and desirable characteristics of a really good glass color is its ability to withstand discoloration . . . the ability of the color to offset darkening by sulphide fumes. Pemco's TU-IB white is just such a color . . . the outstanding glass color to meet this requirement.

Widely used by lighting unit manufacturers TU-IB matures to a glossy finish even at low firing temperatures. Because of its high opacity, more units can be sprayed per pound of enamel — with the corresponding reduction in manufacturing cost. In matching sequence there are Pemco Glass Colors in pastels as well as white enamels—to simulate acid etched glass. For greater economy—faster production and more satisfactory ware try Pemco's TU Glass Colors.

To prove these facts, write for samples . . . for a production run.

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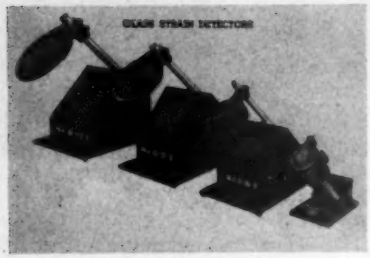

NEW POLARISCOPE DEVELOPED

Eisler Engineering Co., Inc., 750 South 13th Street, Newark 3, New Jersey, has announced the development of a new polariscope design for determining strain in glassware.

The new polariscope consists chiefly of a light diffuser, a polarizer and an analyzer which can be raised or lowered. The analyzer glass plate can be adjusted by revolving clockwise relative to the polarizer. The polariscope, designated the "Black and White" Polariscope, indicates the amount of strain present by the width of the lines making up the black cross pattern in the polarizer.

The polariscopes are made in 3", 6", 9" and 12" sizes, and can be supplied in standard 110 or 220 volts A.C. Sample strain glass is supplied for adjusting the polariscope to the sharpest view.

POCKET COMPARATOR

National Tool Company, 11200 Madison Avenue, Cleveland 2, Ohio, is the distributor of a new instrument, "The Pocket Comparator", a high-precision optical measuring instrument for the inspection of small parts or small dimensions on large parts. Developed and manufactured by Bell and Howell Company, the instrument embodies a principle by permitting the user to compare through a magnifying lens the part to be checked against a finely calibrated pattern or reticle. The lens is a triplet-design aplanatic type having a magnification of approximately 7 to 1.

The reticle of the pocket comparator is calibrated for measuring lengths, widths, complete circles, radii and angles. The upper part of the reticle has lengths graduated in steps of 1/16", 1/32", 3/64", 3/32", 1/8", 3/16" and 1/4". There is also a linear rule of 1/2" with .005" increments, and a 10mm. linear rule with .2mm. increments. Circles are shown graduated from .002" to .050" diameter and from 1/64" to 1/16" diameter. The lower half of the reticle is patterned to measure angles between 0 to 90 degrees in steps of 5 degrees and to measure radii from 1/16" to 3/8".

The pocket comparator separates in the middle for two purposes: the first is to permit cleaning the interior optical surfaces; the second, for adjustment of focal length to meet the eye requirements of the individual using the instrument. It can be used for checking radii, angles, chamfers, threads, small holes, lineal, radial and tangent dimensions, odd shapes, etc., on machined, stamped or cast production parts. It can be used for the establishment of standards and the inspection of bubbles, blow holes, cracks or other flaws in glass parts, die castings, lenses, jewels, etc.

GLO-DUR GLASS COATING

Brooklyn Varnish Manufacturing Co., 50 Jay Street, Brooklyn 1, New York, has announced the development of Glo-Dur, the latest of the industrial finishes developed by the firm. Tuf-On Glo-Dur glass coatings are designed to adhere tenaciously to glass and ceramic surfaces and are formulated as transparent finishes for use on darkroom lamps and as opaque finishes.

The Glo-Dur enamels may be applied by dip or spray. They are fade-resistant and flexible enough to resist embrittlement after hundreds of hours of heat exposure, according to the company's report. Baking time is six minutes at 300°F.

PRELINED MIRROR CLIP

Bull Dog Lock Company, 4638 N. Ravenswood Avenue, Chicago 40, Illinois, has announced the development of a method of preventing metal-to-glass contact on mirrors through the use of its new prelined mirror clips.

The clips are said to eliminate the former method of cutting inserts to size and then hand assembling them between the glass and clips, and overcomes the hazard of the felt inserts shifting out of place. The clips are available in both metal and plastic in a large variety of sizes and types.

DUAL-UNIT AUTOMATIC TIMING DEVICE

Industrial Timer Corporation, Newark, New Jersey, has announced a new timing device featuring two individual timing elements—each able to control a specific operation—accommodated in a single housing. When the timer dials are set to the respective time intervals required, each cycle of operation will follow the other continuously.

The complete control cabinet measures 11½ x 9 x 7 inches, and contains two sockets into which the timing elements are plugged so that they control a single-pole, double-throw load relay. The contact circuit of this relay is unpowered, permitting application of the particular voltage and current necessary for test or production.

CATALOGUES RECEIVED

Minnesota Mining & Manufacturing Co., 900 Fauquier Street, St. Paul 6, Minn., has announced publication of a booklet entitled "Step Up Production" which is devoted to the use of abrasive belts in industry.

The new booklet provides case-history examples and technical data on grinding and polishing with abrasive belts. Abrasive belt techniques are described and pictured for a variety of materials—glass, ceramics, plastics, castings of gray iron, manganese, bronze and aluminum, etc.

Also covered in the booklet is the new "pre-finishing" technique in which the usual process of steel-forming-and-then-polishing is reversed in order to achieve maximum production line speed. Details are given on belt equipment, belts and various contact wheels that support the belt at the point of contact with the work.

Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia 22, Pa., is distributing a new four-page folder which provides information about a "packaged equipment" that regulates the three important operating variables in industrial and metallurgical furnaces—temperature, pressure and air-fuel ratio—at a high level of efficiency.

Designated ND-600 (1), the new booklet describes how users may obtain increased uniformity of products, faster production, greater fuel economy and longer refractory life.

This integrated control equipment is applicable to a wide variety of furnaces: glass tanks, tunnel kilns, lime kilns, large annealing furnaces, open-hearths and practically any fuel-fired heating equipment.

The folder includes an illustration of a typical control panel with the three sets of controls, a Temperature Controller, a Pressure Controller and an Air-Fuel Ratio Controller, showing how they can be mounted in a central location. A schematic drawing traces the interrelation of these components to make up the complete system.

Asch Equipment Company, 98-11 Queens Boulevard, Forest Hills, New York, has issued two bulletins concerning a new instrument which they have developed for tank level and manometer determinations.

In these bulletins, the Levlocator is illustrated and described. Details of its operations are given, as well as line drawings showing its applications.

Vacuum-Electronic Engineering Co., 316 37th Street, Brooklyn 32, New York, has published a new four-page bulletin featuring the Veeco Mass Spectrometer Leak Detector.

The booklet, Bulletin LD-45, describes typical applications, wherever a vacuum, fixed pressure or special atmosphere must be maintained for extended periods of time; principle of operation, features and pertinent data pertaining to vacuum testing and pressure testing with explanatory illustrations.

IT'S THE TIMING THAT COUNTS

Aerialists float through the air with the greatest of confidence because their timing is right. You can fire your ware with confidence when Drakenfeld's "timed-right" colors are used. For our "know-how" and many years of experience in developing colors that meet strict specifications can help you minimize rejects, boost production and increase profits.

Throughout the country, manufacturers of ceramic ware are using Drakenfeld's dependable service and research facilities to meet their individual production techniques. If you want a special color created, or an "old timer" brought up to date, our skilled technologists will gladly cooperate. Or if you are in the market for high-quality coloring chemicals and supplies, we feel confident that our product quality and uniformity will give you the results you want.

We would like nothing better than the opportunity of discussing the advantage of our cooperative service with you. Get in touch with us for a meeting date to suit your convenience.

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Drakenfeld

MECHANIZATION OF THE GLASS INDUSTRY, PART I . . .

(*Continued from page* 80)

manual movement of fine sand from the settle vats.

Cranes and mechanical tongs greatly reduced the labor of moving pots in and out of the melting furnaces and the casting of plates on tables. Coal was mechanically unloaded and conveyed to automatic stokers in the boiler room and to gas producers. Trolleys and cranes did much of the work of shifting glass plates to and from storage racks.

Many other minor tasks were performed by motor driven devices too numerous to justify space for illustration and description. During the first two decades of this century important developments in the grinding and polishing operations were made. The most important of these was the invention of the movable table to replace the stationary table which was a fixed part of the grinding machine. Coincident with this was the change from square reciprocating polishing machines with straight line motion for the polishing pads to a rotary system where polishing was done by pads suspended and freely rotating in much the same way as the grinder runners. This made a great improvement as it enabled the polishing and grinding to be done with only two laying or bedding operations compared to four. There were two other steps one of major importance between the process shown on Fig. 1 and the process of Fig. 2.

The continuous tank, the ribbon rolling, and the continuous travel of the ribbon through the lehr made a semi-continuous process. The rough plate was cut from the moving ribbon as it left the lehr into plates of even length. These were laid on square tables mounted on axled wheels running on a track.

The tables were coupled in much the same way as railroad cars were coupled together to form a train except that they were connected in such a way as to form a single long table which moved continuously beneath, first sets of power driven grinder blocks, then through an empty space where the plaster joints between plates were cleaned and the embedded grinding abrasive removed. Then new plaster was filled into the joints and the glass passed beneath power driven polisher pads for polishing without removal of the glass from its plaster bed while the long table was moving.

Next, the continuity of the process was interrupted by uncoupling the cars, the glass was removed and stacked while the plaster was removed, the glass turned polished side down and again laid in plaster. This uncoupling, glass removing, plaster removing and relaying was originally done in a sort of yard similar to a railroad yard with tracks and switches for shifting, then the cars made up another continuous table or train to repeat the operation for the other side.

Later, the uncoupling and switching were eliminated and the glass lifted and relaid in a space between the polisher which had completed the first side and the next set of grinders and polishers which finished the other side.

After this the cars were uncoupled and shifted back by a return track carrying the empty cars back to the end of the lehr where the ribbon was leaving the lehr. This is the system used in most modern plants now and approximate the fully continuous system shown in Fig. 2. The latter system is used in only one plant according to my information, and is the truly completely mechanized automatic process. It eliminates the laying operation, eliminates plaster, which is an expensive material, reduces power required for polishing, and considerably reduces the number of man hours.

The development from the process of Fig. 1 to that of Fig. 2, even though the actual glass working was unchanged, gives us a simple, clear picture of the outstanding law of evolutionary progress "Efficiency in the Movement of Materials".

Before concluding this chapter, mention of an intermediate development, the Bischeroux process, is justified for the purpose of showing conversely that leaving the true path of evolutionary progress results in failure or stalemate.

Movable table (round) type grinder showing runners and drawing spider, 1902.

Movable table (round) type polishing machine, 1902. Table moving into operating position.

The messy and laborious fine sand grading for grinders, about 1900.

The Bischeroux process used the ribbon rolling of the continuous process with pots for melting instead of tanks. It is an intermittent instead of a continuous process and could never hope to attain ultimate success because it turned its back on the fundamental law of efficient materials movement, and based its hope on solving certain problems which beset the path of development of the continuous tank ribbon system.

It lacked potential, but promised and secured a temporary advantage. It is still used to a consiredable extent and for a time appeared superior to the continuous system owing to certain unsolved problems in the early development of the continuous system. The latter system had two difficult problems to solve:

First, tank made glass was inferior (on the average) to pot melted glass. Second, mechanical and other difficulties were responsible for keeping the width of the ribbon and consequently, the maximum size limit of plates too low to meet a considerable portion of the plate market.

The Bischeroux process solved both these problems almost from the start. It even permitted the use of continuous grinding and polishing. But today the width of tank melted ribbon rolled continuously made glass has increased over 600% and the tank furnace by means of improved controls and expert and alert management now produces glass that is as good or better (on the average) than pot melted glass. This despite the fact that the tank furnace is crude as an engineering development, and no important radical improvement has been made for one hundred years. The pot furnace has reached its zenith, whereas the tank furnace has great unrealized potential improvement.

This is not an academic question. The large plate glass empires have maintained their position precisely because they refused to turn their backs on the basic path of evolution, and accept palliatives or substitutes, and eventually tanks will be developed to attain their potential.

Pittsburgh Plate Glass Co.

Continuous grinding, 1949.

In the following installments covering the window glass and container glass industries, which will appear in the next two issues of THE GLASS INDUSTRY, I hope to show that in both industries exactly the opposite thing happened. At least two companies whose developments had raised them to undisputed leadership lost that leadership through failure to persist in following the true path of successful evolution when that path was clearly defined or else delayed until other firms passed them and wrested leadership from them.

CORNING ANNOUNCES TELEVISION TUBE DEVELOPMENT

The laboratory development of a new electrically conductive opaque coating for the inside surface of television picture tubes has been announced by John L. Ward, Manager of Corning Glass Works' Electrical Products Division.

This coating, which can be applied at the time of manufacture of the glass bulb, will eliminate the need for carbon coating the bulb by laborious hand methods in television tube-making plants, according to Mr. Ward's announcement. Also, because the bulbs can be coated by Corning at the time of manufacture, this operation will be eliminated at the tube-maker's plant. In addition, the new coating is permanently fused to the surface of the glass and will not be affected by washing or other reclaiming operations.

Mr. Ward stated that this is a completely new type of coating with all the desirable features of the presently-used carbon coating, such as non-reflectivity and opacity. Tests of the new coating in Corning's research laboratories have already indicated these practical advantages. As soon as facilities for commercial production are available, the company plans to coat all its glass television bulbs with the new material. The ease of applying the new coating, Mr. Ward pointed out, will simplify the final assembly of the new rectangular all-glass tube and speed its adoption by the television industry.

GLASS INDUSTRY TO BE DEVELOPED IN INDIA

Development of a major glass industry in India, following on the independence of the country, is promised by plans now formulated. The Australian Consolidated Industries, Ltd. is to purchase a substantial holding in the Bombay Glass Works and the Allahabad Glass Works and assume the responsibility for the large scale development of India's glass industry.

An Australian, W. J. Smith, is to become Managing Director of the company to be formed, which will be an Indian firm, taking over the Indian and Pakistan rights of the Australian company.

Two sheet glass factories are proposed for the Allahabad company and glassware manufacture for the Bombay Glass Works. The move will make the Indian continent largely self-supporting if the plan is carried through.

WHAT CONSTITUTES GOOD GLASSHOUSE IRONS . . .

(*Continued from page* 83)

be solid and free from flaws and imperfections. Secondly, it must be of such a nature that it is readily workable in the mold shops. The other paramount characteristic should include resistance to heat checking, resistance to surface disintregation and scaling, and, for certain applications, good thermal conductivity, elasticity and strength.

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GLASS FIBERS ADDS TO STAFF

Hugh W. Paul has joined Glass Fibers, Inc., as special assistant to the President, according to an announcement by R. H. Barnard, President of the organization.

Mr. Paul has formerly been associated with Owens-Illinois Glass Company in various administrative and sales capacities, most recently as Vice President of American Structural Products Company, an Owens-Illinois subsidiary. Previously he had been with U. S. Gypsum Company.

LYNCH GLASS MACHINERY DIVISION ADDS FOREIGN REPRESENTATIVE

The addition of a full time glass-forming machinery representative in the South American territory has been announced by the Glass Machinery Division of Lynch Corporation.

James W. Rainwater has been selected for the new position and will arrive in South America the latter part of February, at which time he will join A. G. Doll, Vice President of the firm, who is already making a tour in that area. Mr. Doll hopes to introduce Mr. Rainwater to many South American glass companies prior to his return to this country.

Mr. Rainwater has had a wide experience and familiarity with Lynch glass forming machinery during his twenty years service with various productive departments of Ball Brothers Company. He will assist Lynch customers in checking their machine installations and in establishing operational standards and performance data.

DUNBAR GLASS ELECTS NEW VICE PRESIDENT

The Directors of Dunbar Glass Corporation have announced the election of Hugh M. Seyfarth as Vice President in charge of Sales.

Mr. Seyfarth joined Dunbar in 1937 as a salesman in the company's Chicago office. In 1938, he was promoted to Manager of the Chicago offices, in which job he remained until the middle of 1949 when he was appointed General Sales Manager and he was transferred to the firm's general offices.

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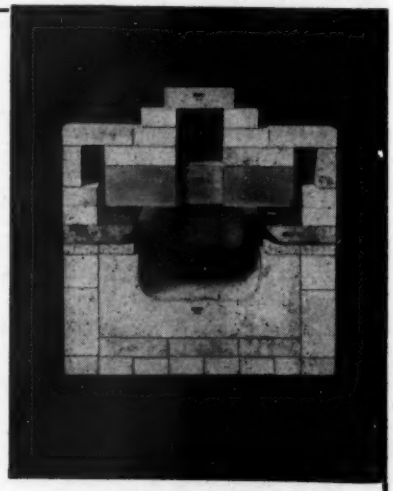

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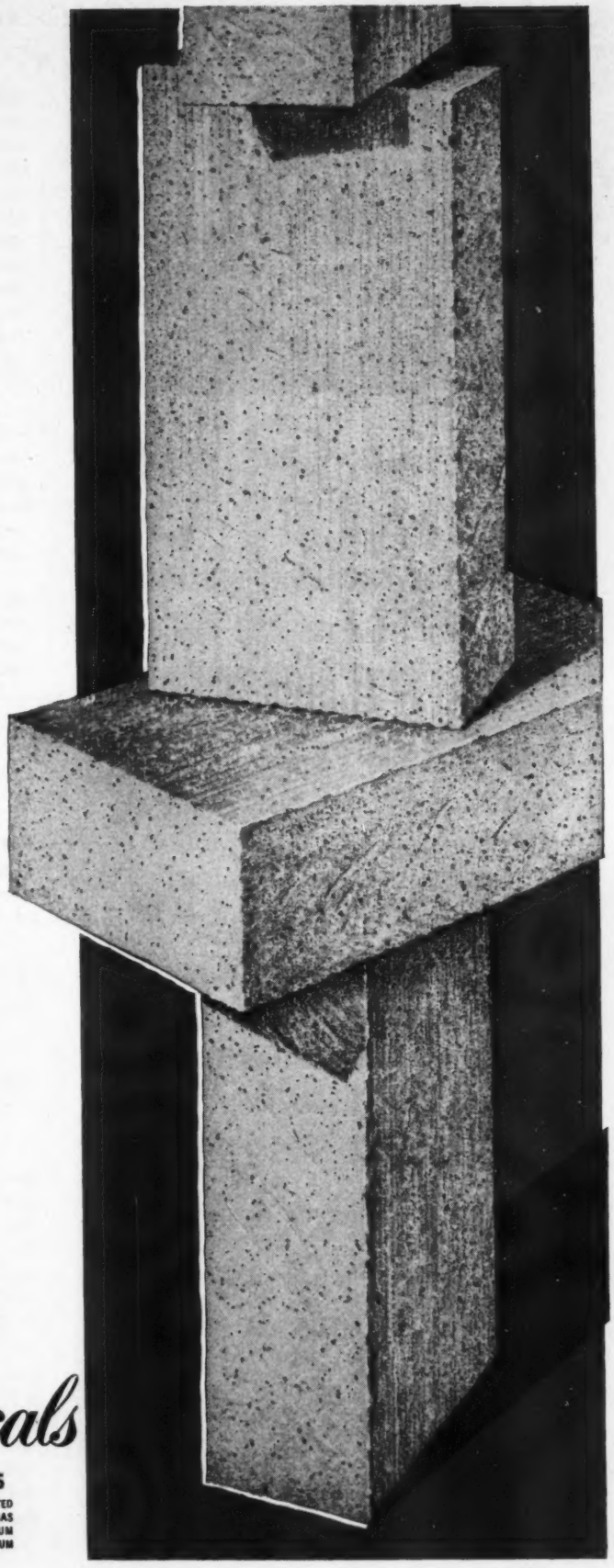

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RECENT RUSSIAN TRANSLATIONS . . .

(*Continued from page* 86)

Above this temperature the density of glass everywhere corresponds to the temperature of the spot, and below this temperature the density everywhere is as it was at T_g whatever the actual temperature. In reality, this change in behavior occurs within a temperature range but calculations are greatly simplified when a definite point on the temperature scale is substituted for this range. The temperature T_g can be found in Fig. 3 as it is the temperature at which the mobility of glass changes most, i.e. at which the curves of Fig. 3 possess an inflexion point. This temperature depends on the thickness of the plate. When this increases from 2 to 26 mm., T_g decreases almost linearly from 570°C to 537° (1058°F — 999°F).

The third assumption is that during the whole important part of cooling the temperature T at a point (in the plate) situated x cm. from the middle plane of the plate is given by the equation

$$T = T_m \frac{\delta_1}{\sin \delta_1} \cos \frac{\delta_1 x}{a}$$

In this equation T_m is the average temperature of the plate, a the thickness of the plate (in cm.) δ_1 is the first root of the equation $\delta \tan\delta = h\,a$, h being the relative coefficient of heat loss (in cm^{-1}).

The final formula is

$$f(x) = \frac{\beta E T_g}{1-\sigma} \left(\ln \cos \frac{\delta_1 x}{a} - \frac{1}{a} \int_0^a \ln \cos \frac{\delta_1 x}{a}\, dx \right).$$

In it $f(x)$ is the final stress in the plate (which stress is function of x), β is the linear coefficient of heat expansion of glass, E the modulus of elasticity, and σ the Poisson ratio of the glass. The expression

$$-\frac{1}{a} \int_0^a \ln \cos \frac{\delta_1 x}{a}\, dx$$

can be expanded into the series

$$\frac{\delta_1^2}{6} + \frac{\delta_1^4}{60} + \frac{\delta_1^6}{315} + \frac{\delta_1^8}{1332} + \ldots .$$

This gives the equation

$$f(0) = \frac{\beta E T_g}{1-\sigma} \frac{\delta_1^2}{6} \left(1 - \frac{\delta_1^2}{10} \right)$$

as a useful approximation for the stress in the central plane of the plate (i.e. at $x = 0$). Because δ_1 depends on the plate thickness a (according to $\delta_1 \tan\delta_1 = ha$), this equation determines the relation between $f(0)$ and a. Fig. 3, in which the ordinate is proportional to $f(0)$, allows this conclusion to be tested, and the theory proves to be correct.

The analogous series for $f(x)$ is

$$f(x) = f(0) - \frac{\beta E T_g \delta_1^2}{2\,a^2(1-\sigma)} x^2 - \frac{\beta E T_g \delta_1^4}{12\,a^4(1-\sigma)} x^4 - \ldots .$$

The results shown in Fig. 3 confirm this expression as well.

However, the curves "Δ against T_c" shown in Fig. 3 deviate from the theory when T_c is smaller than, equal to, or but slightly greater than T_g. This in all probability is caused by the crudeness of assumption 2 above.

RESEARCH DIGEST . . .

(*Continued from page* 95)

If batch changes occur yielding a glass of lower density, this lighter glass tends to remain on the surface, does not readily mix with the glass below it and may pass undisturbed through the throat, particularly if the latter is near the glass surface or is unduly worn upwards. If the batch changes give a glass of greater density, this may tend to sink and so displace the formerly quiescent lower layers of glass in the furnace which may be drawn into the main stream of glass passing to one of the machines.

If some segregation of the batch occurs, then clearly we may have small streams of glass quite close together and all at the same temperature, but with markedly different chemical compositions. A glass stream containing soda substituted for silica or for lime will have a higher thermal expansion than the parent glass and higher expansion than is shown by a stream where silica has replaced lime or vice versa. Thus, if we find an increased density spread associated with severe inhomogeneity producing marked strain, we may conclude that the soda content of the glass has varied.

Studies of density spread on glass samples taken under a variety of conditions yield many interesting conclusions, among which the following may be cited:

a) Bottles made on suction machines which use a revolving pot generally show a smaller density spread and greater homogeneity than samples taken from feeder-fed machines. When suction and feeder-fed machines are working on the same furnace, the glass going to the suction machine is generally lower in density than glass passing to feeder-fed machines.

b) The density spread and the degree of inhomogeneity each increases and the general density level fluctuates more when the glass loads are high, i.e., when the melting rate exceeds the value corresponding to 8-9 sq. ft./ton glass. Glass conditions are worse when the area needed to melt one ton of glass falls below this value.

c) If cullet of unknown and variable compositions from a variety of sources is used in ever-increasing quantities, the density spread increases and the means density level fluctuates. For the closest glass control, such foreign cullet should be reduced as far as economics permit. Customer's cullet and factory off-ware do not, of course, present the same difficulties.

d) Density spread is larger in the case of colored glasses than it is with colorless glass. The colored glasses have a steeper temperature gradient from the upper layers of glass to the bottom of the tank and, in consequence, it is more difficult to obtain homogeneity by thermal currents. The lower layers in the tank are colder and stiffer in the case of colored glasses and the effect is particularly pronounced when an iron-manganese dark-green glass is melted. With this glass, the lower layers are also very susceptible to any batch changes which affect the heat transmission through the upper layers. The lower layers may become more mobile if the heat transmission increases or may become more viscous if the heat transmission is reduced. If such batch changes occur simultaneously with changes of glass load or of furnace temperature, the glass passing to the machines may become markedly non-homogeneous.

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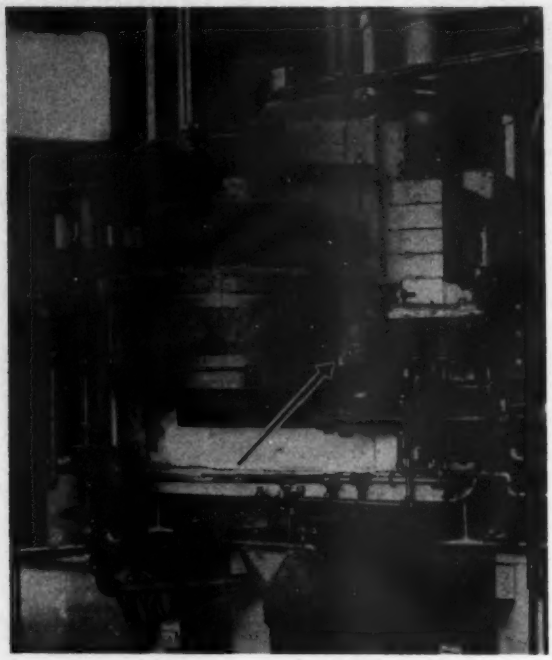

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PEMCO APPOINTMENTS

The appointment of Lyman C. Athy as Technical Assistant to the President of Pemco Corporation has been announced by Richard Turk, President.

In his new post, Mr. Athy will consult with the staff on technical matters and direct his efforts towards coordinating and expediting research and development, manufacturing procedures and problems, and customer problems and customer service.

The firm has also announced that Wilfred M. Paquin has joined the Pemco Service Department as a Service Engineer for the Ohio-Indiana area.

Mr. Paquin is a graduate of the New York State College of Ceramics, Alfred University, and brings to Pemco several years of extensive production, research and management experience having been associated with Ferro Enamel Corporation, Norge Division of Borg-Warner Corporation, Quaker Chemical Company, O. Hommel Company and as joint owner of Paquenamco, Inc.

THE GLASSICLE . . .

(*Continued from page 84*)

icicles representing all ages and sizes up to the granddad of them all, three feet from head to tip. The icicles were sealed at the tips and provided with a short neck in which a cork could be inserted after they have been filled with water. A collar can be blown in the neck to assist in attaching the icicle under the eaves of a house or within a cover of synthetic snow. Shown are three types of neck-fitting, including a glass hook sealed on the head of a large icicle, made for the film "Scott of the Antarctic". The still, which appears on Page 84 of this issue of THE GLASS INDUSTRY and which is taken from a scene in a crevasse from that film, shows the "glassicles" mounted in snow, and is reproduced by permission of Ealing Studios.

HAZARD CONTROL FOR GLASS BATCH PLANTS . . .

(*Continued from page* 87)

5. Proper locker rooms and lunch room should be provided for the employees' use close to, but not exposed to the mixing materials.

6. Eating of candy bars, sandwiches, etc., should not be allowed on the job. Restrict eating to places provided.

7. Periodic health examinations including chest X-rays and blood and urine tests afford a continual check on how carefully the mixing plant is being operated.

It will be noted that nothing has been said about dust collecting systems. If the above suggestions are followed, it will be found that at the most only a small fan and collector will be required to maintain a slight negative pressure at the points noted.

The capital outlay ordinarily put into dust collecting systems can be better invested in enclosures to make the collection unnecessary, thereby saving the power for operation, the maintenance cost, and the loss of material.

No specific equipment has been mentioned here as details, choice of types of conveying, weighing and mixing machinery must be made to suit individual requirements and taste, but all of them can be safely built, installed or purchased to conform with the principles outlined herein.

UNDERGRADUATE FELLOWSHIP ESTABLISHED AT ALFRED

The establishment of an undergraduate fellowship in the Department of Glass Technology by the Dominion Minerals, Inc. has been announced by Dean John F. McMahon of the New York State College of Ceramics at Alfred University. The fellowship is the fifth to be established for undergraduate students in the college.

L. Jay Conklin, a senior in the Department of Glass Technology, has been appointed to work on the fellowship under the direction of S. R. Scholes, department head. Mr. Conklin will investigate and develop uses for aplite, an alumina bearing mineral, in the manufacture of glass. The Dominion Minerals firm manufactures raw materials for the glass and pottery trades.

Mr. Conklin, whose home is in Avoca, has been employed in the research department of Libbey-Owens-Ford Glass Company. He is a member of the student branches of the American Ceramic Society and the American Chemical Society.

L-O-F APPOINTMENT

R. Arthur Gaiser, for more than seven years active in the research problems dealing with films on glass with Libbey-Owens-Ford Glass Company, has been promoted to assistant director of research in charge of the Glass Films Section of the Research Department.

Mr. Gaiser has been supervisor of the research program which brought out Electrapane, a glass with a transparent electrical conducting film, used extensively in anti-fogging and defrosting windows for airplanes during the war. He has also been active in the study of films for low and high reflection glass, and has conducted much research in his field with the electron microscope in connection with the University of Toledo.

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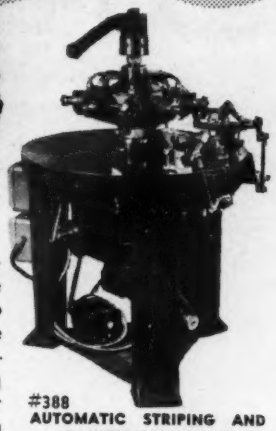

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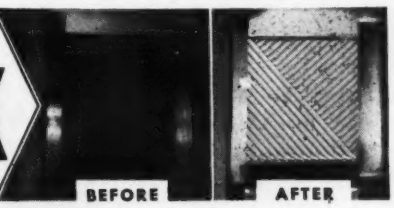

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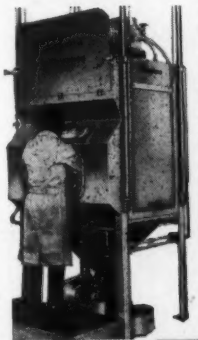

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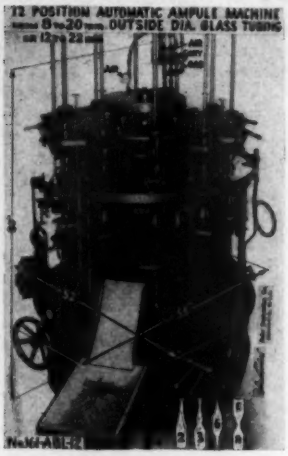
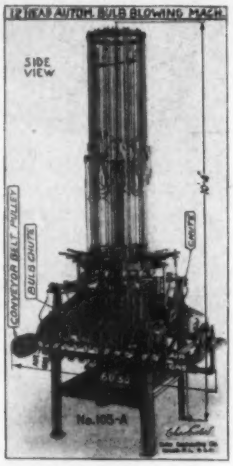
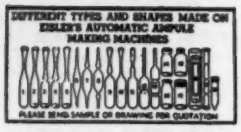
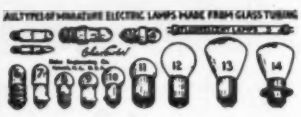





DIFFERENT TYPES AND SHAPES MADE ON EISLER'S AUTOMATIC AMPULE MAKING MACHINES
PLEASE SEND SAMPLE OR DRAWING FOR QUOTATION



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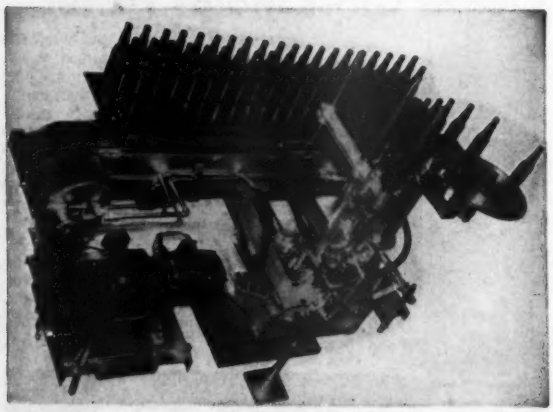

GLAPAT CORPORATION
Zanesville, Ohio

PPG TRAFFIC MANAGER RETIRES

After fifty years of service in the Traffic Department of Pittsburgh Plate Glass Company, Addison J. Sevin has retired from active service, according to a recent announcement.

Mr. Sevin has served as General Traffic Manager for the firm since 1931, having joined the Traffic Department in 1899 as a clerk and stenographer. He had served as chief clerk for thirty years.

CORNING ESTABLISHES TWO NEW DEPARTMENTS

The formation of two new departments, Lamp Sales and Electronic Sales, to handle the sales activities of the Electrical Products Division of Corning Glass Works, has been announced. Establishment of these departments, according to the company's announcement, was necessitated by the rapid expansion of the firm's television business during the past two years.

Thomas S. Wood, associated with Corning for the past twenty years, has been appointed Manager of the Lamp Sales Department. John S. Muller, with the firm since 1941, has been made Manager of the Electronic Sales Department.

INNIS, SPEIDEN VICE PRESIDENT RETIRES

E. T. Ladd, Vice President in charge of the Isco Chemical Division of Innis, Speiden & Company, has announced his retirement.

Mr. Ladd is retiring from active management under the retirement policy of the company. He will continue his association of more than thirty years with the firm in an advisory capacity.

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NEW PRESIDENT FOR SOUTH AMERICAN CORNING PLANT

Corning Glass Works has announced that Fernando M. Carles of Buenos Aires, Argentina, has been made President of Corning Glass Works of South America, S. A. Mr. Carles succeeds Mr. Eugene W. Ritter, who has resigned to take up advanced studies at Princeton.

A native of Argentina, Mr. Carles was educated in England and France. In 1922, he joined the foreign service of the National City Bank of New York in the Rio de Janeiro, Brazil Branch. He subsequently served in the branch in Paris and as Manager of the Buenos Aires branch.

REPORT ON BUSINESS BY DOMINION GLASS

Present indications are that the ensuing year will be a favorable one, L. J. Belnap, President, told shareholders of Dominion Glass Co. Ltd., at the annual meeting.

He said management looked for "favorable operations" throughout the year and that the company's plants are in better shape than ever before. However, he added, several million dollars will still have to be spent on plant improvements to put them into condition believed necessary and to reduce costs. He pointed out that during the year the company spent $888,673 in a program of modernization and replacement which was started several years ago.

• Karl Turk, Jr., Vice President of Pemco Corporation, has been elected to serve on the Board of Directors of the Associated Industries of Maryland, Inc. for 1950.

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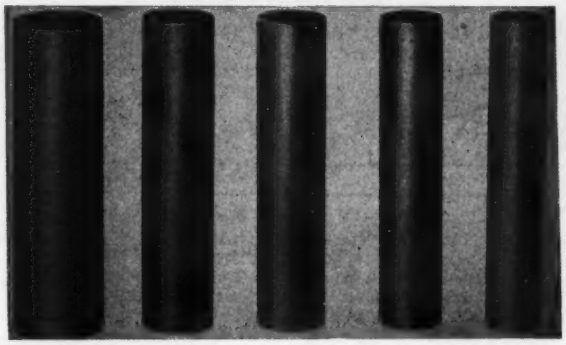
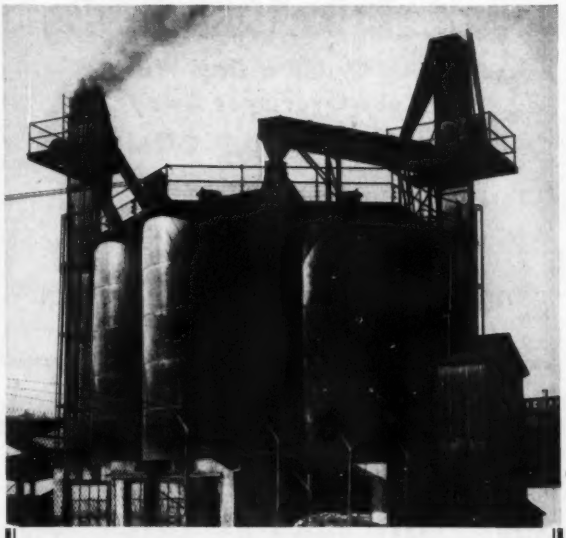
GUNITE



ROUND BAR STOCK

Gunite can be machined with relative ease, yet has a high density that will take a brilliant polish. Round Bar Stock is available in 18 sizes from ¾" to 5" diameter, all bars 14" long. There is a suitable Gunite alloy for many types of glass-making castings such as Plungers, Ring Sticks, Neck Rings, Guide Rings, Moulds, Blanks, Bottom Plates, etc.

GUNITE FOUNDRIES
ROCKFORD, ILLINOIS



FOR SALE—A Complete Batch Plant

• A modern, labor saving plant comprising six raw material bins of 2,680 cu. ft. capacity each, and one central bin of 7,850 cu. ft.; 4,000-lb. Toledo hopper scales; Smith Mixer; Link-Belt power unloader; two bucket elevators, together with drives, motors, controllers, etc. This plant is located in the Pittsburgh area, can be purchased, dismantled, moved and re-erected at a fraction of its original cost.

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